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CURTIS GATES LLOYD

H. M. FITZPATRICK

(WITH PLATE 12)

In the passing of C. G. Lloyd, American mycology has lost one of its distinctive personalities. Recognized as the world's outstanding authority on the Gastromycetes, he was indeed an international figure. His numerous publications, privately printed and freely distributed, made his name familiar to correspondents in every country and clime, while the humorous digressions and biting satires which enliven his pages have long constituted a distinct source of entertainment for the mycological public. In the limited compass of this sketch it is impossible to give more than an abbreviated account of his life and work, but emphasis will be placed on some of the more striking aspects of his unique individuality.

During the last year of his life Mr. Lloyd was stricken with rapidly failing eyesight, and several months before his death was forced to abandon entirely his mycological studies. In June, he received the honorary degree of Doctor of Science from the University of Cincinnati in recognition of his contributions to mycology. He died November 11, 1926, in Bethesda Hospital in Cincinnati, Ohio, at the age of sixty-seven.

He was born at Florence, Kentucky, July 17, 1859. His father taught in a country school there. When Lloyd was nine years old the family moved to Crittenden, Kentucky. Such schooling as he had was obtained in the country schools. He never attended any institution of higher education. When a young man he went to Cincinnati to make his own way, and

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obtained employment there as an apprentice and bottle-washer in a retail drug store. He must have given himself wholeheartedly to the task of learning the drug business, for at the age of 25 he formed, with his two older brothers, John Uri Lloyd and Nelson Ashley Lloyd, the firm of Lloyd Brothers. The firm prospered and soon became one of the best known wholesale pharmaceutical houses of the Middle West. In 1918, Mr. Lloyd retired from the firm with a considerable fortune, and at his death left an estate valued in excess of \$750,000.

From boyhood Lloyd had been keenly interested in flowers, and he took up early as a hobby the study of taxonomic botany. He had already acquired a personal herbarium of the flowering plants of the eastern United States when, through contact with Professor A. P. Morgan, he was influenced to transfer his attention to the fungi.

Morgan, on account of failing health, had retired to a small farm near Preston, Ohio, not far from Cincinnati. Lloyd became acquainted with him and visited him frequently there. Morgan's interest in Gastromycetes was imparted to Lloyd, and Lloyd has paid tribute to him in one of his papers.¹

About 1905 Lloyd made an arrangement with his brothers, whereby he placed a man in charge of his department in the firm, and retired from active participation in the business. He then gave himself completely to the study of mycology. He soon recognized that to do the most critical work he must see the authentic specimens in the older herbaria of Europe, and he spent much of his time during a period of nearly fifteen years in study abroad. He travelled extensively and browsed about in all of the important museums of the old world. Early in life he had begun the accumulation of books on botany, and this became an obsession with him. He spent much time in the book centers of Europe, purchasing everything that dealt with plants. With his brothers he founded the Lloyd Library in Cincinnati, which has grown to be one of the largest libraries devoted primarily to botany. He provided second-hand dealers with a complete list of the volumes already in the library, and instructed them to furnish anything else that came to hand.

¹ Mycol. Notes 31. 1908.

The library is especially complete on *materia medica* and mycology and contains over fifty thousand volumes.

The Bulletin of the Lloyd Library, published by Mr. Lloyd, consists of 26 numbers. Six of these were written by him on mycological subjects, while the others are chiefly reproductions of rare old prints or papers on pharmacy and entomology. Mr. Lloyd's best known personal publication, *Mycological Notes*, appeared in 75 numbers over a period of 28 years. He published also various special monographs, circulars and letters. His complete works, when bound with the indices provided by him, comprise seven volumes. His contribution to a knowledge of the genera and species of the *Gastromycetes* and certain other groups of the larger fungi will be conceded to be an important one. His papers contain a wealth of information, and are illustrated by hundreds of original photographs. His treatment of groups from the point of view of the world as a whole makes his papers especially valuable. It is to be regretted only that the fragmentary data scattered through his pages were not later reassembled in more usable form. His papers contain much interesting information concerning the foreign museums and herbaria, as well as valuable side-lights on mycologists past and present. The biographical sketches of American and foreign students of the fungi which appeared in connection with a series of portraits published in *Mycological Notes* is one of his outstanding contributions, and of interest to all mycologists.

His publications, distributed gratis to a large mailing list, were always accompanied by the request for specimens of fungi of the groups in which he was chiefly interested. He welcomed all material, whether common or rare, preserved everything, and never tired of naming unidentified collections for correspondents. He received thousands of specimens from collectors in every country of the world. His herbarium is housed in Cincinnati near the Lloyd Library in a separate building named the Lloyd Museum. He published the statement that it "contains ten times as many of the larger fungi as all the other museums of the world combined." The specimens are not arranged in the orthodox fashion. The museum walls resemble those of a shoe-store where boxes of uniform size stand exposed on shelves.

These boxes, when opened, usually reveal many smaller boxes within. Common species are represented by large numbers of specimens, revealing in many cases world-wide distribution. Mr. Lloyd was often able to demonstrate in such an assemblage of specimens intergrading variations revealing the identity of supposedly different species described from widely separated regions. The herbarium is distinctly a personal one and lacks the standard sets of exsiccati so prominent in many others. It is especially rich in Gastromycetes, Polyporaceae, Thelephoraceae, subterranean Ascomycetes, and the larger Pyrenomycetes such as *Xylaria*, *Hypoxylon*, *Hypocrea* and *Hypomyces*. It contains relatively few microscopic or parasitic forms. Mr. Lloyd avoided the use of the microscope in as far as possible. Since he preferred to study only fungi which can be examined satisfactorily in the dry state he gave the Agaricaceae little attention.

At his death he left almost his entire estate to endow the library and museum. They were placed in trust years before to insure their perpetual maintenance. He desired that they "remain free to the public for the benefit of science." It is to be hoped that adequate provision has been made for their proper care.

Mr. Lloyd never married. While in Cincinnati he maintained bachelor's quarters in the museum. So much of his time was spent abroad that he found it desirable to have a European address. He had a permanent office in England and employed a secretary to care for the specimens that came to him there. In later years he spent much of his time during the summer on his country estate in Kentucky. He owned a fine farm of nearly 400 acres containing much virgin timber near Crittenden. He beautified the place by planting roses in mass along the highway, and transplanted to his land the rare native plants of the region. At his death he left the farm as a wild life preserve.

Mr. Lloyd did not attend the annual meetings of his fellow mycologists and botanists, and to many he was not personally known. The writer first met him when he came to Ithaca, in 1919, to examine the larger Pyrenomycetes in the Atkinson herbarium. Mr. Lloyd was much impressed by the natural

beauty of Ithaca, and more especially by the richness of the fungous flora. We spent a pleasant week collecting² with him, and after he had gone we learned that he had quietly and without ostentation purchased one of our favorite collecting grounds, an 80 acre tract of cold upland sphagnum bogs surrounded by wooded hills near McLean, N. Y. It was thus preserved against grazing and logging operations, and having been fenced and provided with a little laboratory building it affords an ideal opportunity for field work in various phases of biology.³ It is called the Lloyd-Cornell Reservation. Later, Mr. Lloyd purchased 436 acres of wild land nearby, at Slaterville Springs, designating it as a wild-flower preserve, and shortly before his death added a third, a pot-hole region in beech woods at Ringwood Hollow.⁴ Thus three of the favorite collecting grounds at Cornell were preserved for future generations of students. All of these reservations were placed by Mr. Lloyd in trust, under the local management of a member of the biology staff of the Cornell faculty. He will long be regarded by local botanists as one of our most liberal benefactors.

To the botanical world at large Mr. Lloyd was best known perhaps for his amusing tirades against the prevailing convention of citing authors' names after the generic and specific names of plants. He refused to follow the practice in his own writings and believed sincerely that it is an unnecessary and reprehensible one leading to too hasty publication and unwarranted multiplication of so-called species. From the fact that he published privately he was enabled to make his criticisms distinctly personal, and woe to the mycologist who became the subject of his attack. The most outstanding contribution of this type which came from his pen was *The Myths of Mycology*, published in 1917. In it he says, "the mistakes, blunders, and personal foibles of mycological writers have been my chief source of pleasure. I have never failed to express myself plainly, and have spared neither friend nor antagonist. I have always tried to be good-natured in my comments, and as a general thing the

² *Mycol. Notes* 61, Pl. 137, fig. 1574. 1919.

³ Bulletin 27 of the Lloyd Library. 1926.

⁴ *Mycol. Notes* 74: 1346 and *Science* 64: 570.

parties affected are taking it more as a joke on themselves and an idiosyncrasy of myself. . . . Nor am I deceiving myself into the belief that I will accomplish what I am apparently trying to bring about, the abolition of personal advertisements in mycology."

In the recent numbers of *Mycological Notes*, Mr. Lloyd called attention to the paragraphs in which he ridiculed the work of others by printing alongside of each a cut of a little grinning Chinese idol. This idol was erected by him⁵ to the god Tso Kay, guardian of "priority pedantry, Kuntzeism, and other irregular practices in mycology." The broad grin on the face of the little graven image is in a very true sense emblematic of Mr. Lloyd's attitude toward much of the work that has been published on taxonomic mycology.

Some years ago Mr. Lloyd facetiously presented to his readers as real a wholly imaginary mycologist, Professor McGinty,⁶ who was much given to searching through ancient tomes for forgotten information concerning the fungi. From time to time there appeared in *Mycological Notes* remarkable "new genera," "new species," and "new combinations" attributed to McGinty. It was with the greatest satisfaction that their real author realized later that certain foreign workers were giving these forms serious consideration.

Mr. Lloyd prided himself on his eccentricity. Four years before his death he erected a monument to himself in the cemetery at Crittenden, Kentucky. He said it was intended as "a burlesque on tombstones in general" and a satire on mycologists who have passed "the Osler age." It bears the inscription on the following page.

And now that he lies beneath the stone his friends will realize that he would desire from them no higher tribute than to be remembered with a smile.

⁵ *Mycol. Notes* 72: 1300; 73: 1323.

⁶ Letter No. 48, p. 12. 1913.

CURTIS G. LLOYD

MONUMENT ERECTED IN 1922 BY
HIMSELF FOR HIMSELF DURING HIS
LIFE TO GRATIFY HIS OWN VANITY

WHAT FOOLS THESE MORTALS BE!

NOTE ON MYXOTHECA HYPOCREOIDES AND ITS SYNONYMY

ROLAND THAXTER

(WITH 2 TEXT FIGURES)

In a letter received from Dr. Farlow during a stay of some months in the island of Trinidad, B. W. I., during the winter of 1912-13, he asked me to be on the lookout for a very curious fungus reported by Ferdinandsen and Winge to have been found by H. Lassen, a member of Professor Warming's Expedition to Venezuela, etc., in 1891-92, growing in the Maraval Valley, near Port of Spain, on the fronds of *Trichomanes pinnatum*, and named by them *Myxotheca hypocreoides* nov. gen. et sp. On a first visit to this valley, which is traversed by a partly shaded brook, and, though unduly civilized, proved a rich locality for fungi, the form in question was readily found in abundance not only on *Trichomanes*, but on the fronds of various other ferns, as well as the leaves and even stems of a variety of flowering plants, both woody and herbaceous. Further investigation also showed that it was by no means confined to this locality, but occurred abundantly in various other parts of the island.

As may be seen from the accompanying photograph, very kindly made for me by Professor Weston from dried material, it is conspicuous from its contrasting white color, and occurs in the form of discrete, cushion-like masses, associated in variable numbers on a thin whitish subiculum, which may often have a very distinctly yellowish green tint, that persists, even after prolonged desiccation, in herbarium material. Such a subiculum or thallus is clearly indicated in Figure 1, which represents a specimen found on the leaves of a huge sedge, growing in woods about the Aripo Savanna, near Cumuto.

The cushion-like masses, which suggest in appearance the egg-masses of some minute spider, are flattened and somewhat

uneven above, brittle and friable from the presence of a whitish granular substance which is apparently excreted by the very

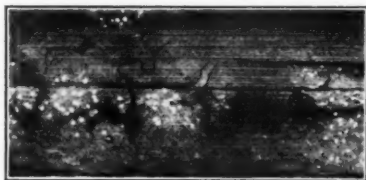


FIG. 1. General habit, on large sedge. Natural size. Trinidad material.

slender branching hyphae. With care, the thin cushions may be lifted intact from the substratum, surrounded by a fringe of the subiculum. When examined under a low power, abundant and irregular loosely branching filaments of some trentepohliaceous alga are usually conspicuous in this fringe, while the cushion itself, in favorable material, is occupied by variable numbers of large, thick-walled asci, sometimes as many as forty or fifty, immersed, discrete and irregularly distributed in a single layer, the algal element being absent or having been destroyed in this region.

The younger asci are more deeply immersed in the matrix of the cushion and are furnished with gelatinous walls of very great thickness. They arise, much like the spores of *Glaziella*, terminally from stout hyphae which lose themselves in the compacted elements of the cushion, although they are described, by the authors mentioned, as radiating from a common center, as if they originated from some definite archicarp. The present writer has been unable, however, to trace them to such an origin. As the ascus develops, it gradually presses outward the surrounding matrix of granules and fine disorganized hyphae, which become compacted to form a more or less definite envelope about it. The mature ascus is not emergent above the somewhat irregular surface of the stroma, which is formed by branching and anastomosing "paraphyses," quite undifferentiated, except by the numerous minute, short, blunt branchlets at their tips; and it seems probable that, when moisture is absorbed, owing to the swelling of the gelatinous ascus-wall and of the surrounding elements of the stroma, the ripe spores are forcibly ejected.

A method of this sort would further explain the minute pits which, like pin pricks, dot the surface of older cushions. The large spores are nearly colorless, usually eight in number, but occasionally less, oblong fusiform, slightly curved, with rounded ends, the concave margin slightly prominent in the mid-region, and are dictyosporic; the transverse divisions fifteen, or somewhat variable in number, more or less discontinuous and irregular; the loculi in each transverse row one to five, and more or less irregular in size and relative position, their contents coarsely granular.

It being evident from the presence of abundant and characteristic gonidia that the plant was one of the innumerable leaf-lichens which so often contend with hepatics to cover coriaceous leaves in moist shady situations in the tropics, it was sent, with other miscellaneous lichens collected in Trinidad, to Dr. Vainio, whose report on the small collection submitted to him has been published in the Proc. Am. Acad. Arts & Sci. (58: 131-147. Ja 1923). In this paper the species under consideration is referred to the lichen-genus *Arthonia* (Arthothelium) and treated as a variety *hypocreoides* (Ferd. & Winge) Vain. of *A. candida* (Krempelsh.) Vain., one of the many interesting forms discovered by Beccari in Borneo, and originally described by Krempelhuber as *Myriostigma candidum* nov. gen. et sp. in a privately printed paper entitled "Lichenes foliicolae" (1874), and later republished in the Nuov. Giorn. Bot. Ital. (7: 45. 1875). Although the white cushions, or stromata (apothecia), are two to four times as large in Beccari's plant, it appears to correspond very closely to the West Indian form, and the generic name used by Krempelhuber was suggested by the presence, in older specimens, of the numerous minute pits "quasi acu facta" above referred to, and regarded by him, for some reason which is not evident, as being apothecia. In both papers a second species, *M. cardinale*, found on bamboo in India, is referred to, but not described, although two spores are figured in the second paper. Some years later J. Müller-Argau, who had examined the original Beccari specimens, in his Lichenolog. Beitr. (Flora 73: 194, 1890), remarks of Krempelhuber's type of *Myriostigma* "est vera Arthothelii species et dein *Arth. candidum* Müll.-Arg. nominandum est,"

also stating that it is nearly allied to *A. leucocarpum*, a corticolous form described by him in Proc. Roy. Soc. Edinb., Session 1881-82, p. 468, from material collected by Balfour in the Island of Socotra, northwest of Africa.

There are thus three forms to which that described by Ferdinandsen & Winge is closely related, but there seems some doubt as to its absolute identity with either. Whether a careful comparison of all four would show essential differences is uncertain; but it may be remarked that the somewhat peculiar shape of the spores of the West Indian type, owing to their curvature and the rather characteristic median enlargement on

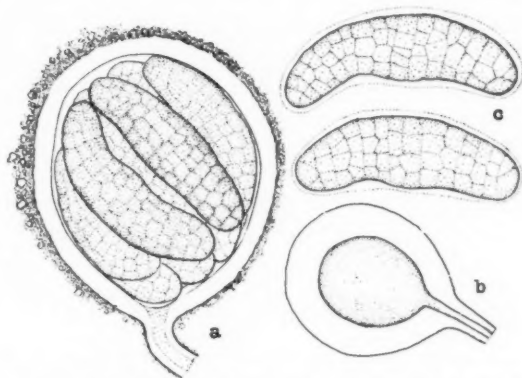


FIG. 2. *a*, Ascus from type of *Ascomycetella filicina* Ellis & Ev. *b*, young ascus from same showing thick wall. *c*, two spores from Trinidad material.

the concave side, is not mentioned in the other descriptions; and the gross dimensions of the apothecia in the Bornean form, to which it is referred by Vainio as a variety, are from two to four times greater. In view of the latter circumstance, Vainio remarks, in the paper cited, that "forsan est autonoma species."

In looking over proof for the new edition of the Farlow & Seymour Host Index which is being prepared by Mr. Seymour at the Farlow Herbarium, the writer was struck by the fact that the Jamaican *Ascomycetella filicina* Ellis & Ev. was listed under *Trichomanes*, and reference to the original description, in Jour. Inst. Jamaica (1: 247. Ap 1893), seemed to indicate that the forms described on the same host by Ferdinandsen

and Winge and by Ellis were identical. This supposition was confirmed by the examination of a fragment of the original specimen from the Ellis Herbarium, very kindly sent me by Dr. Seaver, one of the asci from which is herewith illustrated in Figure 2, *a*. It may further be mentioned here that a form identical in all respects with that from the West Indies was found by Dr. Linder on his recent expedition to British Guiana.

If, as seems not improbable to the writer, the suggestion of Vainio is correct and the American form proves to be distinct from either of the related species above mentioned, the specific name used by Ellis would of course have priority. The determination of this point, however, should be left to European lichenologists who have access to the original specimens. It is evident, however, from what has been said, that *Arthonia candida* var. *hypocreoides* (Ferd. & Winge) Vainio, *Myxotheca hypocreoides* Ferd. & Winge and *Ascomycetella filicina* Ellis & Ev. are synonymous.

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NOTE

Since the above was in type Professor Zahlbruckner has very kindly sent me a specimen of the original gathering by Beccari of Krempelhuber's *Myriostigma candidum*, which, although differing in its much greater size and more conspicuous and copiously developed grey-green thallus, seems identical in its microscopic characters with the West Indian form.

CULTURAL LIFE HISTORIES OF DIAPORTHE.

II¹

LEWIS E. WEHMEYER

(WITH PLATES 13-15)

The life histories of the following species of *Diaporthe* present additional evidence for the fact, previously mentioned by the writer (21 & 22), that the species of this genus possessing a *Phomopsis* type of imperfect stage have certain correlated characters in the perithecial fruit body. These species have two-celled hyaline ascospores and, in most cases, have a differentiated entostromatic area which is more or less completely circumscribed by blackened zones within the substratum. Of the following species, the only one (*Diaporthe decedens* (Fries) Fuckel) which does not show such a blackened zone under natural conditions produced marginal lines in culture, showing that even this species has the potentiality of forming such zones.

DIAPORTHE MEGALOSPORA

This species was described by Ellis (6, 235) from Manchester, Mass., on *Sambucus canadensis* L. The material used as a source of the following cultures was collected at Waverly, Mass., on the same host, and agrees perfectly with Ellis' description.

The fungus is often scarcely visible on the surface of the twigs. In some cases the ostioles are erumpent as numerous, short, conical to cylindrical, spine-like projections; in other cases the ostioles fail to break through the periderm and grow along laterally beneath this tissue for some distance; again, under moist conditions, the ostioles may be larger and much elongated (1-3 mm.). The entostroma is effuse. The surface of the wood is blackened, forming a dorsal bounding zone. The bark tissues are mostly disintegrated. The dorsal blackened zone

¹ The work reported in this paper was carried out at Harvard University under the grant of a National Research Fellowship in the Biological Sciences.

rarely extends into the disintegrated bark, except where pycnidial stromata are formed, where it extends upward over the surface of these. Ordinarily, there is no darkened ventral zone present. At the lateral margins of the entostromatic areas a blackened zone extends 1-2 mm. into the wood, and there is often a greenish discoloration of the wood outside these areas (PLATE 13, FIG. 5), but no definite bounding line. The perithecia are spherical or somewhat flattened; they are $400-575 \times 320-400 \mu$, and buried in the wood. The asci (PLATE 14, FIG. 3) are clavate, have a refractive ring in the apex, and measure $65-90 \times 11-15 \mu$. The spores (PLATE 14, FIG. 4) are biserial in the ascus, cylindrical-fusoid, 2-celled, hyaline, constricted at the septum, usually somewhat curved or inequilateral, and $24-39 \times 3.5-5.5 \mu$.

A suspension of ascospores of *Diaporthe megalospora* Ellis & Ev. was sprayed onto agar on Sept. 20, 1925. Twenty-four hours later these spores were germinating by means of a single germ tube $2-3 \mu$ in diameter. The spores did not swell upon germination.

On October 15, pycnidia were found in single spore cultures on Leonian's agar. These pycnidial stromata originated as superficial knots of intertwined hyphae. In the first stromata formed, conidial formation was initiated very early, while in the succeeding formations the stromata reached a much larger size before conidial cavities arose. As a result the pycnidia varied from 85 to 550 μ in diameter.

The origin of the pycnidial cavity and the production of conidia begins over a more or less irregularly flattened zone within the pycnidial stroma, or sometimes at several different points within the same stroma. The first indication of the formation of such a conidial cavity is the appearance of a zone of active, deeply staining cells, richly filled with protoplasm. These cells elongate radially and may have comparatively heavy walls like the neighboring stromatic hyphae. The conidial locule originates as the result of a plane of cleavage within this area of meristematic cells. Within this cleavage area the walls of the cells are dissolved or gelatinized and the protoplasts grow out as active conidia producing cells or conidiophores (PLATE 14, FIG. 2), which are $2.5-3.5 \mu$ in diameter. The first

conidia formed are of the filiform hamate type. They arise as small bud-like outgrowths of the above-mentioned cells, and grow out to the mature cylindrical form. The alpha conidia are formed later as the swollen tips of more or less elongated sterigma-like outgrowths of the conidiophore cells (PLATE 14, FIG. 2). This formation of an area of meristematic cells and its cleavage to form conidiophore cells progresses laterally until, for one or another physiological reason, the cells with a dense and active protoplasmic content fail to be formed at the margins. Since the outer layers of the stroma soon become inactive and form a protective coat, the progress of this cleavage, especially if it starts in the upper layers of the stroma, is liable to be somewhat parallel to the surface and form a hollow-hemispherical cavity, giving the dome-shaped basal protrusion so common in the form genus *Phomopsis*. As rapid conidial production continues the conidiophore cells are used up. As long as they are physiologically capable of doing so, the subhymenial layers of cells become meristematic and take over the function of conidia formation. In this manner the cavity increases in size until it encroaches upon an area of inactive cells. In the smaller, first formed pycnidia the locules are comparatively large and regular in shape, and the stromatic wall is very thin, due to the comparative lack of differentiated outer layers of inactive cells. In the larger, later formed stromata the locules are liable to be comparatively small, flattened and irregular in outline, and the stromatic wall is apt to be much thickened on account of the greater formation of inactive tissue before the initiation of cavity formation.

There were also formed in this culture large blackened stromatic masses within the agar. Sections through these stromata showed that they corresponded to the entostroma formed on stems. The interior of these bodies consisted of a rich growth of fine hyaline hyphae within the agar substratum. These hyphae took a deeper stain with eosin than the ordinary vegetative hyphae outside these areas. These stromatic areas were sharply defined by a layer of large, closely interwoven, black walled hyphae, forming a peripheral crust. One or more superficial pycnidial stromata were often formed on the surface of

these entostromatic areas, and were then enclosed within a continuation of the outer cortical crust.

From the variations just cited, it can be seen that the size, shape and structure of the pycnidial stroma, pycnidial locule, and so-called pycnidial wall are by no means constant, and are very unreliable as diagnostic characters, at least in *Phomopsis* and related form genera.

When first examined, on October 15, the culture mentioned showed only the beta type of conidia. These were long cylindrical, hyaline, 1-celled, and $14-20 \times 1 \mu$ (PLATE 14, FIG. 6). On November 16, conidia of the alpha type were found in this same culture. The alpha conidia were elliptical to fusoid, hyaline, 1-celled, and measured $10-14 \times 3-6 \mu$ (PLATE 14, FIG. 5). The earlier spore horns, containing only the beta type of conidia, were whitish, while the later ones composed of the alpha conidia were a yellowish-brown in color.

On November 15, 1925, steam-sterilized stems of *Sambucus canadensis* L. were inoculated from a single spore culture. By January 10, 1926, these twig cultures showed numerous stout cylindrical, erumpent ostioles, 2-4 mm. in length. Irregular, pulvinate, stromatic masses were formed within the bark tissues by a proliferation of hyphae and a disintegration of the host cells in this area. When pycnidia are formed, they arise as spherical or irregular locules (PLATE 14, FIG. 1) within this tissue. Conidia of both types were formed on *Sambucus* stems. The alpha type were somewhat narrower than those produced on agar, measuring $10-15 \times 2.5-3.5 \mu$. The perithecia arose as small hyaline knots of hyphae, usually within the wood tissue. They were scattered singly and not definitely oriented beneath the stomata within the bark. These perithecial primordia, very early, gave rise to a massive perithecial neck with a diameter ($120-160 \mu$) often as great or greater than the primordium itself. These perithecial necks push and dissolve their way through the tissues, often growing laterally for some distance in order to reach one of the stromatic areas mentioned, through which they usually become erumpent. No mature ascospores were formed after four months in culture on *Sambucus* stems. A ventral blackened zone was seen on these stems, deep in the wood or within the pith.

Von Höhnelt (14, 118) states that *Diaporthe megalospora* is a *Melanconis* on account of the presence of band-like paraphyses. The writer (21) has pointed out elsewhere that the presence or absence of paraphyses is an unsatisfactory diagnostic character. The presence of a differentiated entostromatic area, marginal blackened zones and a *Phomopsis* stage in the life history shows conclusively that this is a typical *Diaporthe*.

DIAPORTHE PECKII

This species was described from *Rhus Toxicodendron* L. by Peck (17, 52) as *Diaporthe sparsa* Peck. This species name being occupied by the *D. sparsa* of Niessl. (1883), Saccardo (19, IX, 713) designated this species as *D. Peckii* Sacc. The type of *D. Peckii* (Herb. N. Y. Mus., Saugerties, 1885, by Peck) is identical with the material collected on *Rhus Vernix* at Whitmore Lake, Mich., and used as a source of the cultures studied.

This species appears on the surface of the stems as dirty gray erumpent discs, which are scarcely visible and contain 2-5 papillate ostioles; or as more noticeable circular perforations of the periderm; or again, as minute, separately erumpent, conical ostioles. The pycnidia often occur as numerous, minute, pustulate ruptures of the periderm. The entostroma is effuse. An indefinite dorsal blackened zone dips irregularly into the bark between the perithecia, and extends into the wood at the lateral margins of the entostromatic areas (PLATE 13, FIG. 1). There may, or may not, be a ventral blackened zone within the wood, bounding the lower margin of the entostromatic area. The perithecia are spherical, 300-600 μ in diameter, and are either scattered singly or clustered in small groups. They are usually collectively erumpent through a small stromatic disc, but may also, occasionally, be separately erumpent. The asci (PLATE 14, FIG. 8) are clavate, have a refractive ring in their tip and measure 65-85 \times 8-10 μ . The spores (PLATE 14, FIG. 9) are biserial in the ascus, elliptic-fusoid to cylindric-fusoid, usually curved, and often irregular in shape. They are 2-celled, hyaline, constricted at the septum and measure (18) 20-40 \times 3-5 μ .

Suspensions of ascospores were sprayed onto agar on October

7, 1925. These spores were largely immature, and only a few had germinated after twenty-four hours, but after forty-eight hours a number of spores had put out from one to three germ tubes, $3.5\ \mu$ in diameter.

After three to four weeks, single spore cultures on six per cent oat agar produced numerous, gray, spherical, pycnidial stromata, which often possessed a papillate to conical ostiole. These stromata were 0.5–1.5 mm. in diameter. The surface layers of hyphae are blackened to form an outer crust, and the pycnidial stromata are usually seated on an immersed stromatic area, which is bounded by a continuation of this blackened zone. This immersed stroma corresponds to the entostroma formed on stems, as mentioned under *D. megalospora*. There is a rich development of fine, hyaline, deeply staining hyphae within this area.

The pycnidial stromata usually contain a single conidial locule, which is variable in shape and surrounded by a zone of darkened hyphae. The conidiophores are long filiform and bear two types of conidia. The first type formed are the beta conidia (PLATE 14, FIG. 11), which are long filiform, hamate, hyaline, 1-celled and measure $16\text{--}23\ (28) \times 1.5\ \mu$. The alpha conidia are formed later by the swelling of the tips of the conidiophores, and are fusoid-elliptic, hyaline, 1-celled and measure $9\text{--}12\ (15) \times 2\text{--}2.5\ \mu$ (PLATE 14, FIG. 10).

Steam-sterilized stems of *Rhus Toxicodendron* L. and *Rhus Vernix* L., inoculated from single spore cultures, showed pycnidial stromata after three to four weeks. Perithecial initials were not seen until after nine weeks in culture. Numerous pulvinate, grayish to greenish stromata were formed within or beneath the periderm. The pycnidial stromata were composed of broad, upright, parallel, septate, dark colored hyphae, $3\text{--}5.5\ \mu$ in diameter. Within these stromata there were formed one or more irregularly shaped conidial locules. Each locule opened to the exterior through a definite beak-like ostiolar neck, which projected somewhat above the surface of the stroma (PLATE 14, FIG. 7). Conidia of both types were produced in these pycnidia. The fusoid alpha conidia measured $11\text{--}15 \times 2\text{--}2.5\ \mu$, and the hamate beta ones $16\text{--}18 \times 1\ \mu$. Spore horns composed of the

alpha conidia were pinkish in color, while those made up of beta conidia were greenish.

Definite entostromatic areas were formed on these stems. These areas were outlined, both dorsally and ventrally, by a zone of closely interwoven, dark walled hyphae forming a sclerotial layer. In these entostromatic areas, perithecial initials were formed beneath some of the stromatic discs. These stromata usually remained sterile and were not as well developed as the pycnidial stromata.

DIAPORTHE RHOINA

This species was first described as *Diatrype rhoina* Cooke & Ellis by Cooke (4) in 1878. Cooke gave the spores as 1- to 5-septate and $40 \times 4 \mu$. On the basis of these septate spores of Cooke, Saccardo (19, II, 234) placed the species in the genus *Calospora* as *C. rhoina*. Ellis (7, 424) later states that Cooke's measurements are incorrect and gives the spores of his *Diaporthe rhoina* (Cooke & Ellis) as uniseptate and $12-15 \times 2.5-3 \mu$. Ellis' original material of *Diatrype rhoina* (N. Am. Fungi 2d ser. 1953) shows such smaller spores measuring $12-15 \times 2.5-3 \mu$. His later exsiccati of *Diaporthe rhoina* (Fung. Columb. 1046a) and of *Calospora rhoina* (Fung. Columb. 511), however, are both specimens of *Diaporthe Peckii*. As the stromatic characters of *D. Peckii* and *D. rhoina* are at times very similar, it was thought probable that Cooke's original material might have been *D. Peckii*, as his spore measurements agree with that species. Through the kindness of the Royal Botanic Gardens at Kew, the writer was able to examine Cooke's original material. This, as well as two other collections sent by Ellis, all show the small fusoid ascospores, measuring $11-16 \times 2-3 \mu$, which leaves no doubt as to the identity of *Diaporthe rhoina* (Cooke & Ellis) Ellis, nor as to the incorrectness of the original spore measurements.

In 1901, there was issued in Fungi Columbiana (1528) a *Diaporthe confusa* Ellis & Ev. with the note "*Diaporthe rhoina* in N. Am. Pyr. and N. Am. Fungi 3433 and Fungi Columb. 1046." As already mentioned, Fungi Columb. 1046 is in reality *D. Peckii*, while N. Am. Fungi 3433 is issued as a forma *mahaleb*

of *D. rhoina*, on cherry. Fungi Columb. 1528 is the true *D. rhoina*, and *D. confusa*, therefore, is a synonym of this species.

In 1901, Feltgen (8, Nacht. II, 131) described a fungus on *Rhus Vernix* as *Gnomonia rhoina*. Rehm, in a letter to Feltgen, pointed out that this species possessed a black marginal zone and was in reality a *Diaporthe*. In 1903, Feltgen (8, Nacht. III, 145) published the species as *D. rhoina* Feltg. Later, in 1906, von Höhnelt (13, 1250) again pointed out that this was a *Diaporthe* and gave it as *D. rhoina* (Feltg.) Rehm. What is apparently a portion of Feltgen's original material, in von Höhnelt's herbarium (A4051, Jan. 21, 1900), shows numerous, small ($280-320 \times 80-160 \mu$), scattered perithecia within an effuse stroma, bounded by a definite ventral line within the wood. The spores of this specimen measure $13 \times 2-2.5 \mu$. It appears to be a form of *Diaporthe Eres* on *Rhus*, and must await a critical examination of this large group of related species for its final diagnosis.

Material of *Diaporthe rhoina* was collected on *Rhus Toxicodendron* L. near Quincy, Ill., and on *Rhus Vernix* at Waverly, Mass. The fungus appears upon the surface of the twigs as very slightly pustulate clusters of ostioles, barely erumpent through a minute yellowish or blackened stromatic disc, which crumbles away with age leaving a mere perforation of the periderm. The entostroma is effuse. There is a dorsal blackened zone on the surface of the bark; this zone dips irregularly into the bark between the perithecial groups. The entostromatic areas of the bark are usually light in color. The perithecia are spherical or somewhat flattened, $375-500 \times 275-350 \mu$, and are scattered singly or in small groups either in the bark or wood, but are usually collectively erumpent. On *Rhus Toxicodendron* the pustulate areas containing the perithecial groups are more strongly developed and often appear as isolated stromata. The dorsal blackened zone penetrates through the bark and obliquely into the wood at the margins of the fruiting areas, but very rarely continues beneath as a ventral bounding line (PLATE 13, FIG. 2). The asci (PLATE 14, FIG. 13) are clavate and measure $45-50 \times 8-9 \mu$. The spores (PLATE 15, FIG. 2) are biserial in the ascus, elliptic-fusoid, 2-celled, hyaline, constricted at the septum and measure (11) $12-15 \times 2.5-3$ (3.5) μ .

Suspensions of the ascospores from twigs of *Rhus Toxicodendron* were sprayed onto agar on November 15, 1925. After forty-eight hours, one free spore and all of the spores within one ascus had germinated. The spore had not swollen and produced 3 germ tubes $3-4\ \mu$ in diameter.

Cultures on oat agar, from the single spore, produced pycnidia, and entostromatic areas as described for *D. megalospora* and *D. Peckii*. There was formed a loose superficial mat of mycelium within which pycnidia arose. On the agar surface against the test tube walls, there were formed irregularly effused entostromatic areas outlined by a blackened, somewhat raised zone on the surface. In some cases this blackened zone merely penetrated slantingly into the agar for 1-2 mm., while in others it continued ventrally and completely enclosed areas within which there was a rich development of fine hyaline hyphae. Scattered throughout these entostromatic areas there were formed dark colored, erumpent-superficial stromatic discs. Many of these remained sterile, but others produced conidial locules in their interior. These locules contained only one type of conidium, which was long fusoid, 1-celled, hyaline and measured $13-15 \times 1.5-2.5\ \mu$ (PLATE 15, FIG. 1).

On March 10, and April 3, 1926, inoculations were made from the single spore culture onto stems of *Rhus Toxicodendron* and *R. Vernix* respectively. After two months, both of these cultures showed a number of grayish, pulvinate, slightly erumpent pycnidial stromata, but no signs of perithecia. The pycnidia (PLATE 14, FIG. 12) consisted of irregular stromatic masses, formed beneath the periderm or partially within the bark, and containing elliptical or irregularly shaped conidial locules, which were often incompletely surrounded by a zone of darkened hyphae. Conidia of the alpha type only were found in these locules.

On *Rhus Toxicodendron*, numerous, irregular, blackened zones were formed in the bark and often extended into the wood, but, as is characteristic of this species, these zones seldom completely outlined the enclosed areas ventrally. On *Rhus Vernix* these black zones were only occasionally seen, extending through the bark from the pycnidial stromata to, but not into, the wood.

DIAPORTHE DECEDENS

The synonymy of a number of species of *Diaporthe* on *Corylus* is interwoven with that of *Diaporthe decedens* (Fries) Fuckel. These relationships will be considered after looking at the life history of *D. decedens* itself.

Material of this species was collected on *Corylus americana* Walt. near Ann Arbor, Mich. When young, it appears on the surface as numerous, small, circular, pustulate, ectostromatic discs, 0.2–0.4 mm. in diameter. As the perithecia mature these discs fall away leaving circular perforations about which the papillate ostioles become separately erumpent through the surrounding periderm. These ostioles may also be scattered singly, as minute pustules, over the surface of the twig. There is no blackened zone in either the wood or the bark, and no true entostroma. The perithecia are spherical or flattened, $480\text{--}720 \times 320\text{--}480 \mu$; they are in loose clusters or scattered singly, but always separately erumpent (PLATE 13, FIG. 3). The asci (PLATE 15, FIG. 4) are clavate, with a refractive ring in the apex, and are $65\text{--}85 \times 10\text{--}15 \mu$. The spores (PLATE 15, FIG. 7) are elliptic-fusoid, 2-celled, hyaline, constricted at the septum, acute at the ends and variable in size. When young, the spores are $13\text{--}18 \times 3.5\text{--}4.5 \mu$, but when fully mature they are $14\text{--}22 \times 4\text{--}6 \mu$. Faint hyaline appendages are sometimes present on these spores, especially when immature, but these are not a constant character.

A suspension of ascospores from *Corylus* was sprayed onto agar on October 10, 1925. These ascospores measured $14\text{--}18 \times 5 \mu$, but were apparently immature as they failed to germinate. A few twigs were consequently placed in a damp chamber and allowed to remain there for four days. At the end of this time the spores measured $14\text{--}22 \times 5\text{--}5.5 \mu$, and some of the spores showed the evanescent appendages. Sprays of these ascospores germinated readily within twenty-four hours. A single germ tube was produced. This germ tube was narrow ($1.5\text{--}2 \mu$) at the point of emergence from the spore wall, but rapidly increased to a diameter of $4.5\text{--}5 \mu$.

Single spore cultures on oat agar produced a superficial mycelial mat within which were formed numerous spherical

pycnidial stromata, 400–600 μ in diameter. Many of these stromata remained sterile, but others produced a central, irregular to spherical cavity in a manner similar to that described for *D. megalospora*. The walls of the outer layers of hyphae of these stromata were thickened and blackened. Conidia of two extreme types, with many intermediate forms, were cut off from a hymenium of filiform conidiophores lining the locule. One type of conidium (PLATE 15, FIG. 5) was elliptic-fusoid to elongate-fusoid, straight, hyaline, 1-celled, and $11\text{--}15 \times 2\text{--}2.5 \mu$. The second type of conidium (PLATE 15, FIG. 6) was narrower, cylindrical, hyaline, 1-celled, usually somewhat curved and measured $8\text{--}13$ (15) $\times 1\text{--}1.5$ (2) μ . There was a layer of large thick walled hyphae in the surface layers of the agar, but no blackened zones penetrated into the substratum as in the other species discussed.

On November 5, twigs of *Corylus americana* Walt. were inoculated from a single spore culture. Numerous erumpent-superficial, white stromata were formed on the moister portions of these twigs, and on February 9, 1926, both pycnidia and perithecia were found.

Small, scattered, conical ectostromata, 300–700 μ in diameter, were formed on the bark surface just beneath the periderm. The small, irregular or spherical conidial locules (PLATE 15, FIG. 3) were formed either in these ectostromata or in the entostromatic tissues of the bark beneath. Only the allantoid beta type of conidium was found on these twigs. The spore horns were yellow in color.

The perithecia formed were scattered, or in small groups throughout the bark, but were not oriented in any definite manner beneath the ectostromatic discs. The perithecial necks penetrated separately through the periderm itself and not through the stromatic discs, although they were often clustered beneath these discs. Mature asci and ascospores, which measured $12\text{--}18 \times 3\text{--}4.5 \mu$, were produced.

This species is given throughout the literature as lacking any blackened zone in the bark, and the writer has never seen any such zone in any material collected in the field. This lack of any dark colored zones and the presence of a *Phomopsis* type of imperfect stage seemed to make this species an exception to

the general rule that the species of *Diaporthe* possess both of these characters, as already pointed out. In culture, on *Corylus*, however, definite black zones were seen penetrating through the bark and into the wood at the lateral margins of what were, apparently, entostromatic areas (PLATE 15, FIG. 3). Only very rarely were these zones seen to continue horizontally. Here, then, we have a species which has the potentiality of producing such blackened marginal zones but practically never does so under ordinary conditions. This fact together with the scattered, separately erumpent character of the perithecia and the numerous intergrading forms of conidia formed in agar cultures might be considered as evidence pointing to this species as a primitive form of the genus.

This species was apparently first described by Persoon (18) as *Sphaeria decedens*, under *S. tessella*, and as differing from that species in the absence of any dark line. Fries (11, 49) described it as *Sphaeria decedens* Fries, stating that it had no distinct disc and that the perithecia were either solitary or gregarious and separately erumpent. Fries (10, 405) also described a *Sphaeria tessera* on *Corylus*, which he states is similar to *S. tessella* Pers., but with the perithecia aggregated and forming an erumpent cortical disc. In 1859, Berkeley and Broome (2, 364) described *Diatrype pyrrhocystis* on *Corylus*. Both the original description and the type collection of *D. pyrrhocystis* (Rab. Fung. Eur. 136) show that it has clustered perithecia with a slight development of entostromatic mycelium about them, resulting in a flat cortical disc as described by Fries for *S. tessera*. The perithecia of this species are smaller than those of *Diaporthe decedens*, and the spores are somewhat larger ($21-27 \times 6-8 \mu$), are more rounded at the ends, and are more constantly appendaged. In 1869, Fuckel (12, 204) described this species as *Diaporthe pyrrhocystis* (Berk. & Br.) Fuckel and stated that according to Nitschke it was synonymous with both *S. decedens* Fries and *S. tessera* Fries. In 1871, Fuckel (12, Nacht. I, 30) recalled this statement and erected two new species, *Diaporthe decedens* (Fries) Fuckel with appendaged spores measuring $12 \times 4 \mu$ and *Diaporthe tessera* (Fries) Fuckel with non-appendaged spores measuring $14-16 \mu$. The ascospores

of *D. decedens* are slow in maturing and show a range of spore measurements wider than those covered by Fuckel's two species. The effect of maturing in a damp chamber, already mentioned, and the examination of a large number of specimens shows this very clearly. The appendages on the spores are only occasionally present and are very evanescent. Fuckel's, two species are undoubtedly the same. The type material of *D. decedens* (*Dialytes decedens* (Fries) Nit., Fuckel, Fung. Rhen. 1983) in the Farlow Herbarium shows nothing but young ectostromata of this species as generally interpreted, which probably accounts for the small spore measurements of Fuckel. The type material of *Diaporthe tessera* (*Wuestneia tessera* Awd., Fuckel, Fung. Rhen. 592) is identical with the material of *D. decedens* collected and described by the writer. This type material also yielded curved conidia measuring $9-18 \times 1.5 \mu$, similar to those obtained in culture.

In 1918, von Höhnelt (14, 120) gave *D. tessera* as having small appendages and as transitional to *D. decedens*. He also gave *Diaporthe revellens* Nit., *D. tumulata* (Cooke & Ellis) Sacc. and *D. pusilla* Sacc. as synonyms of *D. decedens*. This synonymy is incorrect and apparently due to von Höhnelt's conception of *D. decedens*. The single specimen of *D. decedens* in von Höhnelt's herbarium was collected by W. Krieger and is *D. revellens*. Krieger's F. Sax 2468 of *D. decedens* is also *D. revellens*. *D. revellens* is probably the same as *D. Eres* Nit. as the ascus, ascospore and even conidia measurements are identical, and the stromatic configuration is the same. *D. revellens* is easily distinguished from *D. decedens* by the presence of a definite blackened ventral zone in the wood and the smaller ($9-13 \times 2.5-3.5 \mu$) spores. *Diaporthe tumulata*, according to the original description (3, 49) and an exsiccati of Ellis (Herb. N. Y. Mus., Ellis 2366) seems to be the same as *D. revellens*. *Diaporthe pusilla* Sacc. is also this same species. Saccardo (20, 289) says it resembles *D. revellens*, but differs in the smaller, more scattered perithecia. The type collection of *D. pusilla* (Petrak's Fl. Boh. & Mor. 978) and several other collections of Petrak's, in the Farlow Herbarium, show scattered perithecia buried within the wood, but of a size within the lower limits of those

of *D. revellens*. These specimens are identical to Petrak's exsiccati of *D. tumulata* (Fl. Boh. & Mor. 20) and to his forma *immersa* of *D. revellens* (Fl. Boh. & Mor. 1121). They merely represent a form of *D. revellens* on young twigs with thin bark.

From the preceding, therefore, three species emerge. First, *Diaporthe decedens* (Fries) Fuckel which is the *Sphaeria decedens* of Fries and the same as *Diaporthe tessera* of Fuckel. Secondly, *Diaporthe pyrrhocystis* (Berk. & Br.) Fuckel, which is the *Diatrype pyrrhocystis* of Berkeley and Broome and probably the *Sphaeria tessera* of Fries. And thirdly, *Diaporthe revellens* Nit., which is the same as *D. Eres* Nit. and has as synonyms *D. tumulata* (Cooke & Ellis) Sacc. and *D. pusilla* Sacc.

DIAPORTHE STRUMELLA

This species was first described by Fries (9, 101; 10, 365) as *Sphaeria strumella*. In 1846, he (Sum. Veg. Sc., 385) listed this species as *Diatrype strumella*. It was issued by Fuckel (Fung. Rhen. 598) as *Valsa strumella*, and was later placed by him (12, 205) in the genus *Diaporthe*. Winter (23, 654) gives *Sphaeria tentaculata* Batsch (1, 277) and *S. olivacea* Ehr. (5, 16) as probable synonyms. Fuckel's type of *Diaporthe strumella* (Fries) Fuckel (Fung. Rhen. 598) and nearly all other exsiccati examined by the writer agree with Fries' original material of *Sphaeria strumella* (Scler. Suec. 115) and constitute a distinct species. In 1867, Nitschke (16, 246) described *Diaporthe pungens* on *Ribes*. He states it differs from *D. strumella* in its effuse stroma, evenly scattered perithecia, shorter spores and elongated ostioles. Karsten (15, 113) made this species a variety of *D. strumella*. Of the three exsiccati of *D. pungens* seen by the writer, one (Roum. Fung. Gall. 3531) contained only a dothideaceous fungus, while the other two (Syd. Myc. March. 2055 and Pet. Fl. Boh. & Mor. 35) were typical of *D. strumella* with definitely clustered perithecia and spores of the same size. Sydow's exsiccati have elongated ostioles, but this is a variable character and occurred constantly in culture.¹ Von Höhnelt (13, 1255) gives *Diaporthe*

¹ Nitschke's type material of *D. pungens* has since been examined. It is *D. spiculosa* (Alb. & Schw.) Nit., and not *D. strumella* (Fries) Fuckel. The spores are shorter ($11-12 \times 2.5-3 \mu$) than *D. strumella*, and there is no strongly developed ectostromatic disc.

spireaecola Feltg. as a synonym of *D. strumella*. Feltgen (8, Nacht. III, 147) gives the host of his species as *Spiraea* sp., but his material in von Höhnelt's herbarium is labelled as being *Ribes* and is typical of *D. strumella*.

Material of *Diaporthe strumella* was collected on *Ribes* sp. near Ann Arbor, Mich. The stromatic configuration of this species is quite variable. Superficially the stromata appear as minute pustulate clusters of short cylindrical ostioles, or as small, laterally elongated, elliptical discs, 0.5–1 mm. in diameter, with the ostioles scattered over the surface of the disc. The perithecia are spherical or somewhat flattened and 300–400 μ in diameter. They are usually grouped in small clusters beneath a definite cylindrical or conical stromatic disc, but are occasionally more or less scattered. The perithecia lie in a slightly differentiated entostromatic area of the bark. In some cases each group of perithecia lies in an isolated entostromatic area of the bark and is bounded by a dark zone; in other cases the entostromatic areas of the bark are confluent or effuse (PLATE 13, FIG. 4). In either case these entostromatic bark areas are seated on an effuse entostroma within the wood, outlined by a ventral blackened zone deep in the wood, often bordering on the pith. In some cases this ventral zone in the wood is absent or only occasionally visible, due to the fact that the entire woody tissue is entostromatic in nature. The asci (PLATE 15, FIG. 9) are clavate and measure $35\text{--}45 \times 7\text{--}9 \mu$. The spores (PLATE 15, FIG. 10) are biserial in the ascus, fusoid elliptical, 2-celled, hyaline, constricted at the septum and characteristically inequilateral or slightly curved. The spores measure $13\text{--}16 \times 2.5\text{--}3.5 \mu$.

Suspensions of ascospores sprayed onto agar on December 11, 1924, were germinating twenty-four hours later. The germinating spores were not swollen and produced a single germ tube $2.5\text{--}3 \mu$ in diameter.

Single ascus cultures on oat agar, when examined six months later, showed both pycnidia and perithecia. Numerous pulvinate stromata were formed within and upon a superficial mat of mycelium on the surface of the agar. The surface layers of these stromata were composed of a zone of blackened hyphae

which continued into the agar ventrally beneath the fruiting areas, delimiting an entostromatic area beneath the pycnidia. The pycnidial locules were irregular in shape and were bounded by a darkened wall-like zone of hyphae. Conidia of only one type were found on agar. These were the fusoid-elliptic, 1-celled, hyaline, alpha conidia (PLATE 15, FIG. 12) which measured $6-8 \times 2.5 \mu$. The perithecia were formed immersed in the entostromatic areas of the agar. They were usually abnormal in their development but mature ascospores were found in a number of them.

Single spore cultures on sterilized twigs of *Physocarpus opulifolius* (L.) Maxim. produced perithecial stromata but no pycnidia. Later single ascus cultures on *Ribes* sp. made on November 9, 1925, produced both perithecia and pycnidia.

Numerous cylindrical stromatic discs were formed on twigs as a result of a rapid proliferation of mycelium in the upper bark layers. These stromata reach a diameter of $500-1000 \mu$, and occasionally (on *Ribes*) contain one or more small, irregularly shaped, conidial locules, $100-400 \mu$ in diameter. In these pycnidia on *Ribes* a second type of conidium (PLATE 15, FIG. 11) was found. These conidia were long cylindric-fusoid, usually straight or slightly curved, 1-celled, hyaline and measured $11-15 \times 1.5 \mu$.

Numerous perithecia were formed on these twigs, usually in clusters beneath the stromatic discs, through which they were erumpent as fascicles of elongated thread-like ostioles, about 1 mm. in length. The blackened marginal zones were distinct in both the wood and the bark, but were often irregularly disposed due to the excessive stromatic development in culture. Clusters of perithecia were actually developed completely immersed within the pith, as well as in superficial stromatic masses. Normal stromata were also formed, and mature ascospores which were characteristically inequilateral and measured $10-13 \times 2.5-3.5 \mu$ were produced in abundance.

SUMMARY

1. The conidial stage has been obtained from ascospore cultures of *Diaporthe megalospora* Ellis & Ev., *D. Peckii* Sacc.,

D. rhoïna (Cooke & Ellis) Ellis, *D. decedens* (Fries) Fuckel and *D. strumella* (Fries) Fuckel.

2. The imperfect stage was of the *Phomopsis* type in each case, although only the alpha type of conidium was produced in the case of *D. rhoïna*. The beta type of conidium was hamate, filiform in *D. megalospora* and *D. Peckii*, and cylindric to cylindric-fusoid, slightly curved or allantoid in *D. decedens* and *D. strumella*.

3. Cultures from single ascospores gave rise to perithecia with mature ascospores in the case of *D. decedens* and *D. strumella*, and to immature perithecia in the case of *D. megalospora* and *D. Peckii*.

4. *D. decedens*, the only species not showing blackened marginal zones in the substratum under natural conditions, produced such zones in culture, on twigs of *Corylus*, indicating a primitive condition.

5. The formation of the conidial locule in *D. megalospora* is described.

6. A discussion of the synonymy of each species is given.

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EXPLANATION OF PLATES

PLATE 13

Fig. 1. Vertical section through entostroma of *Diaporthe Peckii* Sacc. on twigs of *Rhus Vernix* L.

Fig. 2. Vertical section through entostroma of *Diaporthe rhoina* (Cooke & Ellis) Ellis on twigs of *Rhus Vernix* L.

Fig. 3. Vertical section through pustules of *Diaporthe decedens* (Fries) Fuckel on twigs of *Corylus americana* Walt.

Fig. 4. Vertical section through stromata of *Diaporthe strumella* (Fries) Fuckel on twigs of *Ribes* sp.

Fig. 5. Vertical section through entostroma of *Diaporthe megalospora* Ellis & Ev. on *Sambucus canadensis* L.

PLATE 14

Diaporthe megalospora Ellis & Ev.

Fig. 1. Vertical section through pycnidial fruit body as formed in culture on *Sambucus canadensis* L.

Fig. 2. Vertical section through lateral margin of young pycnidial locule showing method of cavity formation.

Fig. 3. Ascus with ascospores.

Fig. 4. Ascospores.

Fig. 5. Alpha type of conidia produced in culture.

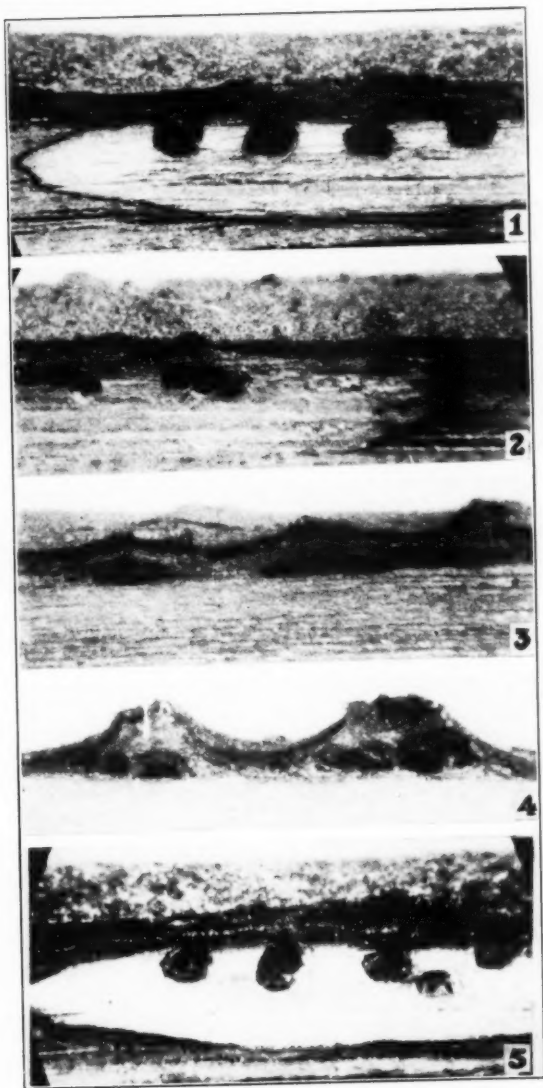
Fig. 6. Beta type of conidia produced in culture.

Diaporthe Peckii Sacc.

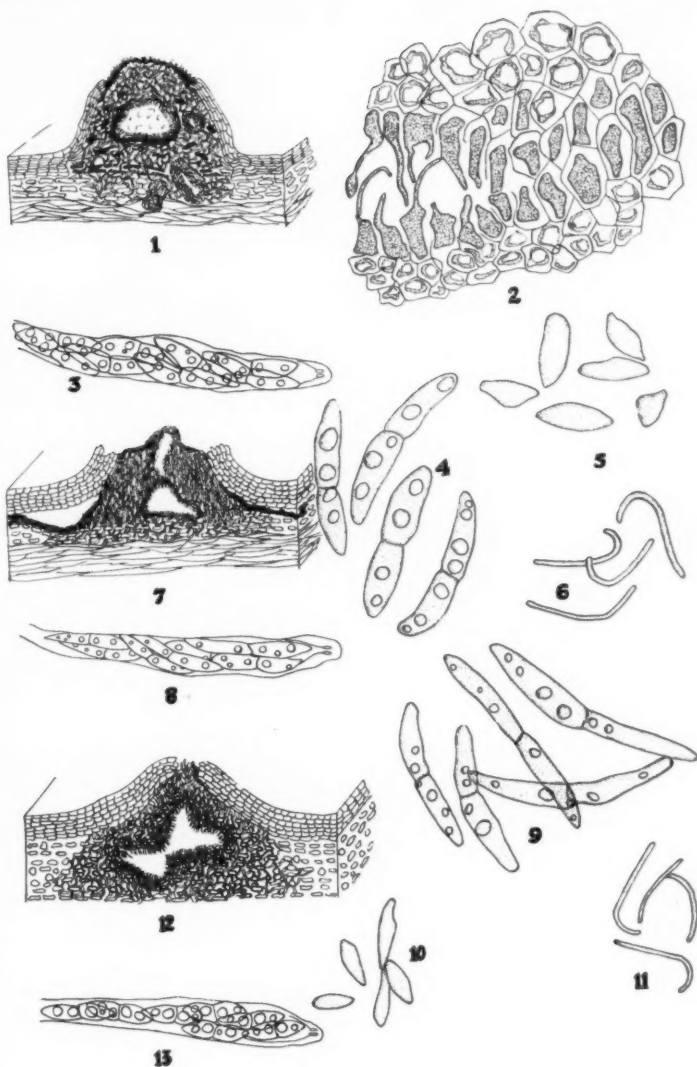
Fig. 7. Vertical section through pycnidial fruit body as produced in culture on *Rhus Vernix* L. and *R. Toxicodendron* L.

Fig. 8. Ascus with ascospores.

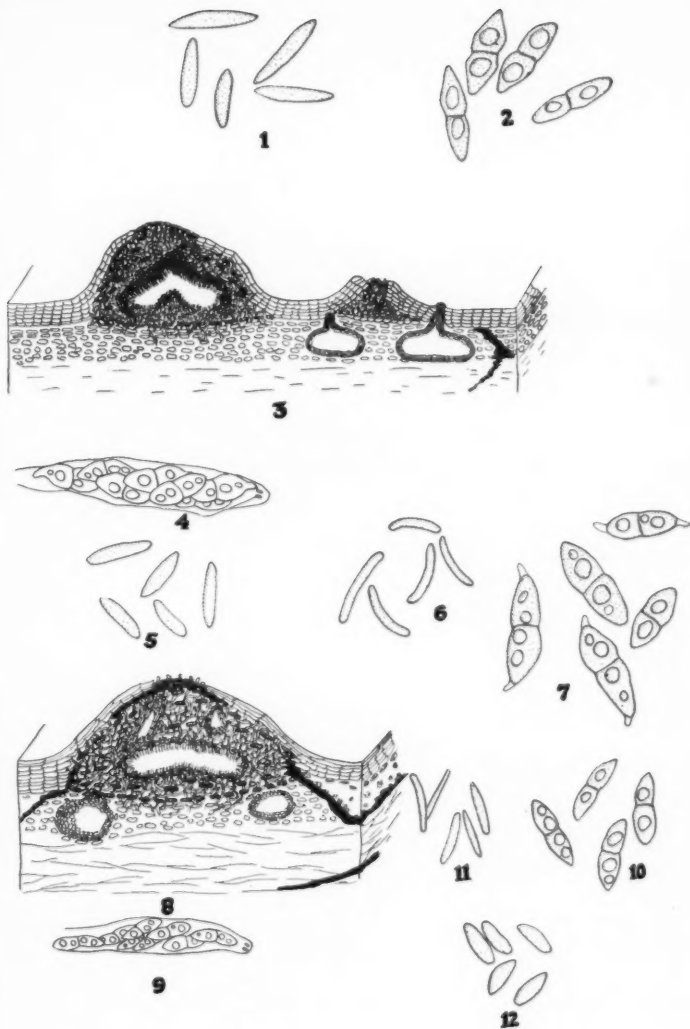
Fig. 9. Ascospores.



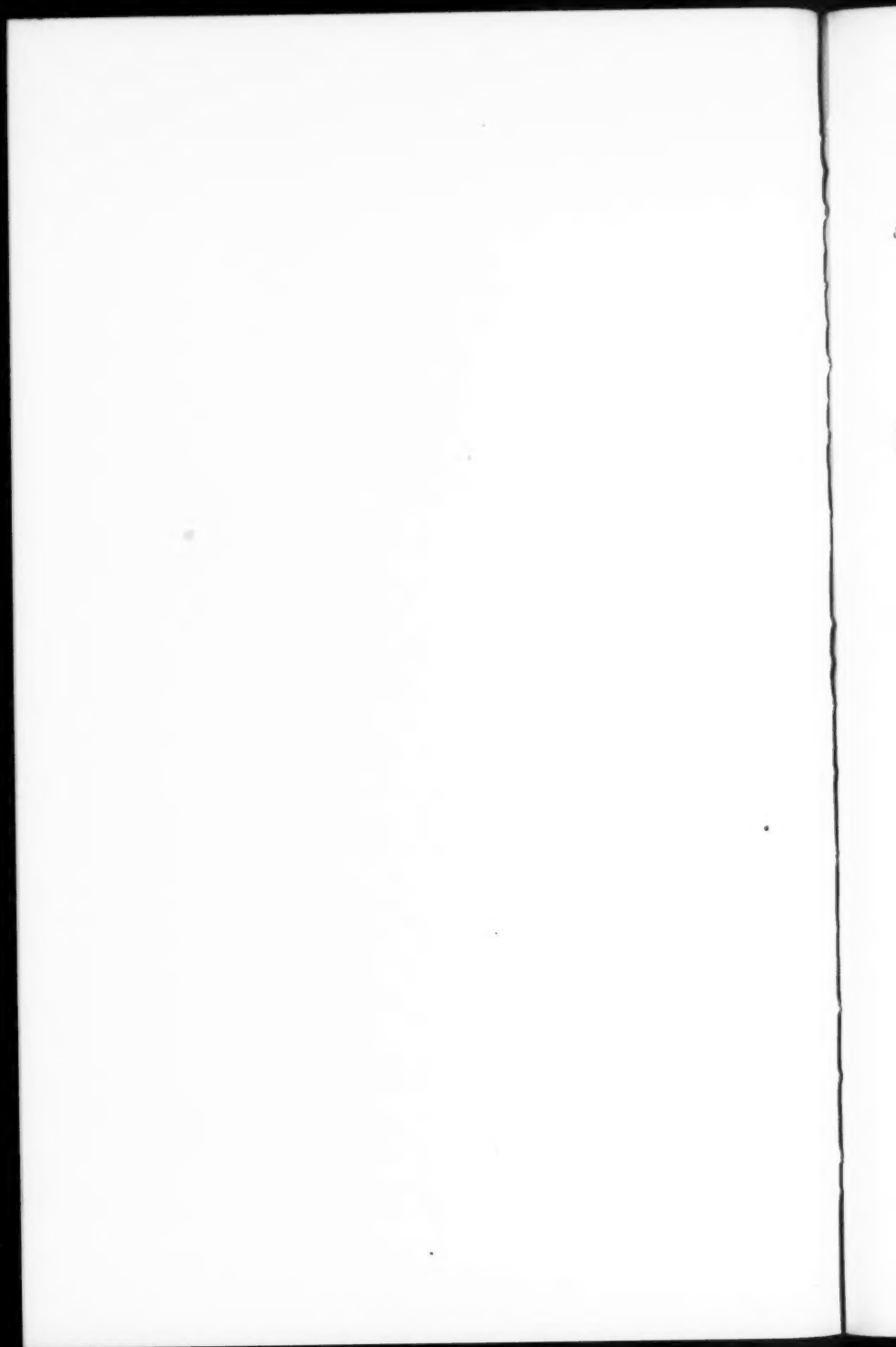
DIAPORTHE SPP.



DIAPORTHE SPP.



DIAPORTHE spp.



- Fig. 10. Alpha type of conidia produced in culture.
Fig. 11. Beta type of conidia produced in culture.
Fig. 12. Vertical section of pycnidial stroma of *Diaporthe rhoina* (Cooke & Ellis) Ellis as formed in culture on twigs of *Rhus*.
Fig. 13. Ascus of *D. rhoina* with ascospores.

PLATE 15

- Fig. 1. Alpha type of conidia of *D. rhoina* produced in culture.
Fig. 2. Ascospores of *D. rhoina*.

Diaporthe decedens (Fries) Fuckel

Fig. 3. Vertical section through fruiting area showing pycnidial stroma, perithecia separately erumpent about an ectostromatic disc, and blackened marginal zone as produced in culture on twigs of *Corylus americana* Walt.

- Fig. 4. Ascus with ascospores.
Fig. 5. Alpha type of conidia produced in culture.
Fig. 6. Beta type of conidia produced in culture.
Fig. 7. Ascospores.

Diaporthe strumella (Fries) Fuckel

Fig. 8. Vertical section of pycnidial fruit body, with perithecial initials in entostromatic area beneath, as formed in culture on twigs of *Ribes*.

- Fig. 9. Ascus with ascospores.
Fig. 10. Ascospores.
Fig. 11. Beta type of conidia produced in culture.
Fig. 12. Alpha type of conidia produced in culture.

OEDOCEPHALUM FIMETARIUM AND PEZIZA VESICULOSA VAR. SACCATA IN MUSHROOM BEDS

F. C. STEWART

During the winter of 1925-26 the writer conducted an experiment with mushrooms in nine small beds, each 1.2×1.5 meters, under a bench in a greenhouse.¹ In beds 1, 2, 4, 5, 7, and 8 horse-manure compost was used. Beds 3 and 6 contained compost prepared from a mixture of bean-straw,² tree leaves,³ and soil. Bed 9 had an 8-centimeter layer of the bean-and-leaves compost in the bottom covered with 13 cm. of horse-manure compost. The beds were spawned on December 1 and cased with 3.5 cm. of sifted loam on December 15.

Between spawning and casing the three beds containing bean-and-leaves compost (Nos. 3, 6, and 9) became almost completely overgrown with a fawn-colored mold from which the six other beds were entirely free. A few days after casing the same mold appeared on the surface of the casing soil in the same three beds. By December 30 it covered about one half of the total surface of beds 3 and 6 and five sixths of the surface of bed 9. At a few points it had climbed over the low board partitions and extended its growth a few inches into adjoining beds, but did not appear elsewhere in any of the six other beds.

When young, the mold is whitish, but it soon changes to fawn-color or pale cinnamon-brown. It is composed of slender, branched, septate, hyaline hyphae which form a thin, loose growth on the surface of the soil over circular areas 7-12 cm. in diameter. Examination with a hand lens reveals multitudes of small, white, spherical bodies borne at the tips of short stalks. Under greater magnification the white bodies are seen to be the

¹ A full account of this experiment will be given in a forthcoming bulletin of the New York State (Geneva) Agricultural Experiment Station.

² Refuse from the threshing of beans consisting chiefly of stems and pods.

³ Principally fresh-fallen leaves of horse-chestnut and maple.

inflated tips of conidiophores with many elliptical, non-septate, hyaline conidia attached. The conidiophores are erect, septate, and usually simple. The conidia measure $6-10 \times 3-3.5 \mu$ and the inflated tip of the conidiophore has a diameter of $25-30 \mu$.

The mold appears to be *Oedocephalum fimetarium* (Riess) Sacc. It has been described and figured by Fresenius (3) under the name *Haplotrichum fimetarium* Riess and by Thaxter (7) under the name *Oedocephalum pallidum* (Berk. & Br.) Cost.

About December 22 apothecia of a species of *Peziza* began to appear outside of beds 3 and 6 along the crack between the cement floor and the boards which formed the walls of the beds. Apparently, mycelium of the fungus in the compost had grown out through the cracks to form its fruit-bodies in the air. A few days later similar apothecia appeared outside bed 9 in the same position, but none ever appeared on the floor around any of the six other beds.

On December 27 *Peziza* apothecia began to break through the casing soil in beds 3 and 6. By January 7 the casing soil in these two beds was cracked and elevated in about 20 places, due, apparently, to forming apothecia. Upon investigation it was found that the apothecia were seated upon the bean-and-leaves compost and only the larger ones were tall enough to reach above the surface of the casing soil. Subsequently, a few surface-growing apothecia appeared in beds 3 and 6 and several appeared, also, in bed 9. Only one apothecium of the subterranean type occurred in bed 9.

In each of four of the remaining six beds there was a single *Peziza* apothecium. These were all of the surface type and in every case situated close to the edge of the bed where there had been an invasion of the fawn-colored mold. That is to say, the *Peziza* apothecia grew only where the fawn-colored mold had appeared a few days earlier.

The free-growing apothecia are at first nearly spherical and whitish. As they enlarge and mature some become cup-shaped or saucer-shaped while others take irregular forms. Those forming beneath the casing soil were invariably very irregular. Mature apothecia are pale yellowish-brown or buff-brown above and whitish beneath. The stem is short and stout. The flesh

is thick and very brittle. The hymenium is usually coarsely ridged in the irregular manner described as cerebriform. The plants grow either singly or in crowded clusters of a few individuals which are sometimes fused into an irregular mass. The apothecia are commonly 5–10 cm. in diameter and often weigh 50–100 gms. each.

Some of the apothecia were quite regular, while others were very irregular. In some the hymenium was nearly even, while in others it was strongly cerebriform. There were, also, all manner of intermediate forms and the microscopic structure was the same in all. Hence, it appears probable that all belong to a single species. Many of our specimens agree closely with Boudier's colored illustration of what he calls *Aleuria vesiculosa* Bull. var. *saccata* Fries⁴ (1) and with Levine's figures of that variety (4, figs. 8, 9). The paraphyses are simple and but slightly thickened at the tip exactly as figured by Boudier. The asci, which are somewhat truncate at the apex, measure $18 \times 255\text{--}330 \mu$ and the ascospores $11\text{--}12 \times 21\text{--}24 \mu$. Upon treatment with iodine the tips of the asci turn light blue.

The appearance of the *Peziza* apothecia exclusively on areas recently overgrown with the *Oedocephalum* strongly suggests a genetic relationship between these two forms. A few attempts were made to grow the two fungi in pure cultures, but as these all failed we are unable to offer any evidence of genetic relationship except such as is furnished by their close association. However, references to such a relationship between *Oedocephalum fimetarium* and species of *Peziza* or *Aleuria* are to be found in mycological literature.

In 1886 Vuillemin (8) described a Discomycete to which he gave the name *Aleuria asterigma*. At the same time he described and figured (but did not name) an associated conidial form which Costantin (2), two years later, referred to *Oedocephalum fimetarium*. In 1891 Thaxter (7) stated that the synonymy of this species was much confused, but that, in his opinion, *Haplotrichum fimetarium* Riess and *Oedocephalum fimetarium* Sacc. should be regarded as synonyms of *Oedocephalum pallidum* (Berk. & Br.) Cost.; also, that Costantin was right in his disposition of Vuil-

⁴ *Peziza vesiculosa* Bull. var. *saccata* Fries according to present nomenclatorial usage in America.

lemin's fungus. On the other hand, Rehm (5) gives *Oedocephalum fimetarium* as the conidial form of *Pustularia vesiculosa* (= *Peziza vesiculosa* Bull. = *Aleuria vesiculosa* Boud.).

According to the description given by Vuillemin, *Aleuria asterigma*, or *Peziza asterigma*, as it is also called (6), is a much smaller and otherwise different fungus than the one which grew in our mushroom beds. However, Boudier is said to have pointed out that it has some analogy to *Peziza vesiculosa* (8).

Levine (4) has reported the occurrence of *Peziza vesiculosa* and *Peziza vesiculosa* var. *saccata* on the manure of newly made mushroom beds under benches in a greenhouse in the vicinity of New York. "The plants appeared in great clusters weighing from 1/2 to 2 lbs." He assumed that either the manure or the soil used in casing was responsible for the presence of the *Peziza*, but suggested that the spawn used was not beyond suspicion. No mention was made of an associated conidial form.

In the case which we have described above neither the spawn nor the casing soil could have been responsible because they were the same in all nine beds, while, with a few readily explainable exceptions, the *Peziza* was confined to the three beds containing bean-and-leaves compost. Clearly, the *Peziza* had its origin in the bean-and-leaves compost.

Edibility tests of the *Peziza* indicate that the fungus is not poisonous but has no value as an esculent.

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GENEVA, N. Y.

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TWO UNUSUAL WATER MOLDS BELONGING TO THE FAMILY LAGENIDIACEAE

G. W. MARTIN

(WITH 1 TEXT FIGURE)

Very few fungi belonging to the Lagenidiaceae have been reported from North America. The two species which are the subject of this note were found attacking a large species of *Cladophora* in West Okoboji Lake, Dickinson County, Iowa, during the summer of 1925. In both instances a relatively small number of cells of the host were attacked, but the fungi are so distinctive as to leave no doubt of their identity in spite of the small number of individuals observed. These species have been known heretofore only from a few isolated localities in Europe.

Myzocyttium proliferum A. Schenk (Figs. 1, 2) was first described from Germany in 1857 as a *Pythium*. The following year Schenk established the genus *Myzocyttium* to contain it. It has since been noted from several European localities on various filamentous green algae and desmids. The primitive mycelial filament breaks up into a chain of bead-like cells, some of which function as zoösporangia, others as antheridia or oögonia (Fig. 1, a). The discharge of zoöspores was not observed in the Iowa material, but the empty sporangia occurring in the same chains of cells as the oögonia and antheridia are striking and unmistakable.

Achlyogeton entophyllum A. Schenk was described in 1859 from Bavaria¹ where it was found attacking *Cladophora* in company with the preceding species, exactly the situation in which it occurred in Lake Okoboji. It resembles *Myzocyttium* in its general aspect, but differs in two important particulars. None of the cells of the filament functions as an oögonium or antheridium but all become sporangia; and the zoöspores, upon discharge, do not immediately swarm, as in *Myzocyttium*, but

¹ Bot. Zeitung 17: 398-400. 1859.

become encysted in a globose cluster at the mouth of the sporangium, as in *Achlya*, each zoospore later escaping for its second active period through a pore in its individual cyst (FIG. 1, c). Sexual reproduction seems to be lacking. In the Okoboji material, however, I find constantly associated with the sporangia, although in different cells of the host, resting spores quite evidently formed by encystment of the contents of a cell similar to that of the cell of an *Achlyogeton* filament (FIG. 1, d).

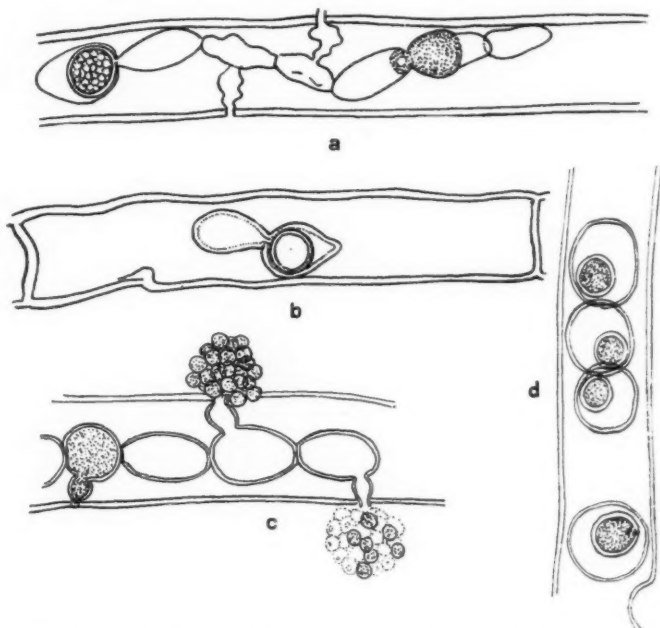


FIG. 1. *Myzocytiopsis proliferum*. Filament in cell of *Cladophora*. At left, mature oospore with adjacent antheridium; center, two empty sporangia; right, fusion of contents of antheridial and oogonial cells; extreme right, empty sporangium; 2. Short filament of two cells functioning as antheridium and oogonium; 3. *Achlyogeton entophyllum*. Part of a chain of sporangia in a cell of *Cladophora*, showing, from left to right, immature sporangium, empty sporangium, spores encysted at mouth of sporangium, cysts nearly all emptied; 4. Asexual resting spores in filament of *Cladophora*. Possibly resting spores of *Achlyogeton*.

a-c, from living material; d, from preserved material. All drawings made with camera lucida using Zeiss objective D and ocular 4, reduced in reproduction to 500 diameters.

There is never any trace of sexual fusion in connection with these bodies. It is possible that they represent resting cells of *Achlyogeton*.

Except for a doubtful reference by Sorokin,² who found what he took to be this species parasitizing eel-worms in the Caucasus, I find no record of its observation since its original description.

² Ann. Sci. Nat. VI. 4: 62-71. 1876.

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A PINK-COLORED FORM OF POLYPORUS SULPHUREUS AND ITS PROBABLE RELATIONSHIP TO ROOT- ROT OF OAKS

H. R. ROSEN

(WITH PLATES 16 AND 17)

For several years a very conspicuous polypore has been found associated with living oak trees on the campus of the University of Arkansas. Most of these trees represent native wild plants that existed prior to the present use of the land, and are over fifty years of age. A number have been cut down and the same polypore noted near the stumps. While one may expect trees that are seventy-five years old or older to show some weakening, yet the marked signs of debility shown by some of them in the form of large, dead limbs and portions of trunks indicate that these trees are probably suffering from additional causes.

The fungus referred to has usually been seen on the ground, near the trees (PLATE 16) or directly at the base of the trunk. Never has it been noted any distance up the trunk, above the soil line, and indeed, superficially, it almost always appears as a soil inhabitant. But without observing the relationship of the fungus to the roots, it has always been a question with the writer whether the polypore had anything to do with the decay of the trees. In the spring of 1926, however, excellent opportunity was afforded to study this, for quite a few fruiting bodies were observed near the base of living, black oak trees. When some of these were carefully dug up, it was observed that the fungus in every instance was growing out of or attached to roots that were badly decayed. These roots in turn were then traced to the trunks of the living oak trees. A conspicuous characteristic of the fungus is its habit of living in and permeating the soil for distances of a foot or more around the rotted roots.

Large chunks of such soil when dug up show a spongy or punky consistency and are speckled with the whitish mycelium. One good distinguishing character of this polypore is the production of turbid drops, which ooze out of the mycelial strands when they are broken or disconnected. These drops are not quite as whitish as the milky juice of such fungi as the species of *Lactaria*. They have been found oozing from the broken surface at the point of union between the pilei and the underground mycelium (PLATE 16, lower figure), from the disjointed mycelium found in the soil, and lastly from the mycelium found within the decayed roots. It is usually not to be observed in the pilei unless these are subjected to pressure.

Attacked roots are very much discolored, the blackish or dark brown color being noticeable clear through a root which is two inches in diameter. Only the cortical regions have been found to be much disintegrated, but the writer is not sure that he has seen all the stages of decay. Small decayed roots as well as large ones having been observed, with the fungus in association, and having in no case observed any decided rotting of the interiors, it may be doubted for the present if this fungus can produce heart-rot.

Aside from its probable parasitic relationships the fungus is also interesting from a taxonomic viewpoint. It appears to be closely related to *Polyporus sulphureus*, and Dr. L. O. Overholts considers it as such. It however shows some marked differences from the usual forms of that species. The surface of the pilei never shows a yellow or sulphur-yellow color, but a very distinct pinkish-salmon color, salmon-buff of Ridgway, when fresh. Upon bruising, the flesh beneath the upper surface becomes conspicuously reddish or flesh colored. The surface of old dried-out pilei is dirty white or cream colored. The hymenial layer is creamy-white and the mouths of the pores never show a sulphur-yellow color. They are either creamy-white or pinkish in very young stages, and when the spores are being formed. In well-developed specimens the pores are markedly daedaleoid (PLATE 17) and the tubes are rarely more than 1 mm. long. The mouths are noticeably notched, irregular, almost irpiciform in fresh material. In dried specimens these features are more

or less completely lost. Due to the fact that the hymenium is mostly found in an underdeveloped stage, spores are rather difficult to find. Out of about seven years of observation, this is the first year that I have found good sporulating specimens. The description of spores of *P. sulphureus* given by Overholts (Washington Univ. Studies, vol. 3, no. 1, p. 24, 1915) fits very well indeed, and in spite of the number of characters which distinguish it from the common (northern?) form, the similarity of spore color, size, and form indicates, perhaps, a close relationship. Another feature possessed by this salmon-colored form, not mentioned for the sulphur-colored one, is a noticeable calcareous incrustation, quite conspicuous on the surface of pilei, limy particles also being observed in microscopic mounts of the hymenial layer. In size this fungus is very variable, but on the whole larger than ordinary clusters of *P. sulphureus*. Measurements up to 60 cm. in the widest diameter are not rare (PLATE 16), although specimens measuring 30-40 cm. are around the average. Hence, if this is to be included in *P. sulphureus*, the measurements of $5-20 \times 4-12 \times 0.5-2.5$ cm., as given by Overholts, would require considerable revision. Measurements of the flesh-colored pilei are $20-60 \times 15-40 \times 3.0-10$ cm. The context is noticeably pinkish for a considerable distance below the upper surface, and grades off into a creamy-white or whitish color near the lower surface. There are no cystidia, but there are numerous sterile, thread-like hyphae at and near the partitions (PLATE 17).

The foregoing description has been submitted to Dr. Overholts for his criticism, and the writer is taking the privilege of quoting a part of his letter. "I believe, for the present, that you are wise in simply noting the points in which it varies from typical *sulphureus*. I still believe there is room in our taxonomic system for those segregates that used to be referred to as varieties, and would suggest that you propose for it a varietal name. I do not think it is entitled to more at present, and I think its variations have never been pointed out—certainly not in *Dae-dalea*."

As Dr. Overholts, an eminent student of the difficult group to which this fungus belongs, has given material assistance in

its identification, the following combination is proposed: *Polyporus sulphureus* (Bull.) Fries var. **Overholtsii** var. nov.

UNIVERSITY OF ARKANSAS,
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EXPLANATION OF PLATES

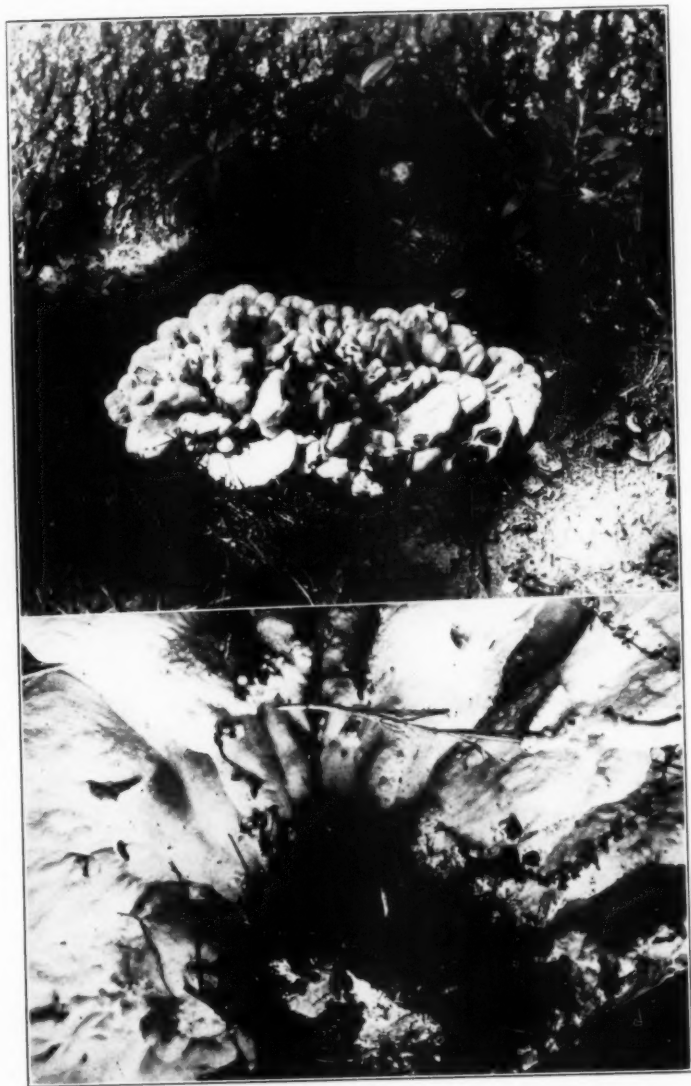
Plate 16. Upper figure. Cluster of pilei of *P. sulphureus*, near the base of a living, black oak. It was carefully removed and the mycelium below it found surrounding and permeating roots of the oak. The cluster measured 60 cm. in the widest diameter. Photographed May 10, 1926, Campus, University of Arkansas.

Lower figure. Hymenial layers bordering the point of union of pilei and mycelium in soil. Notice the large, irregular drop of fluid (exudate) near the patch of mycelium toward center of darkish soil mass. This is the average appearance of a hymenial layer and, being underdeveloped, few spores are to be found. Slightly reduced.

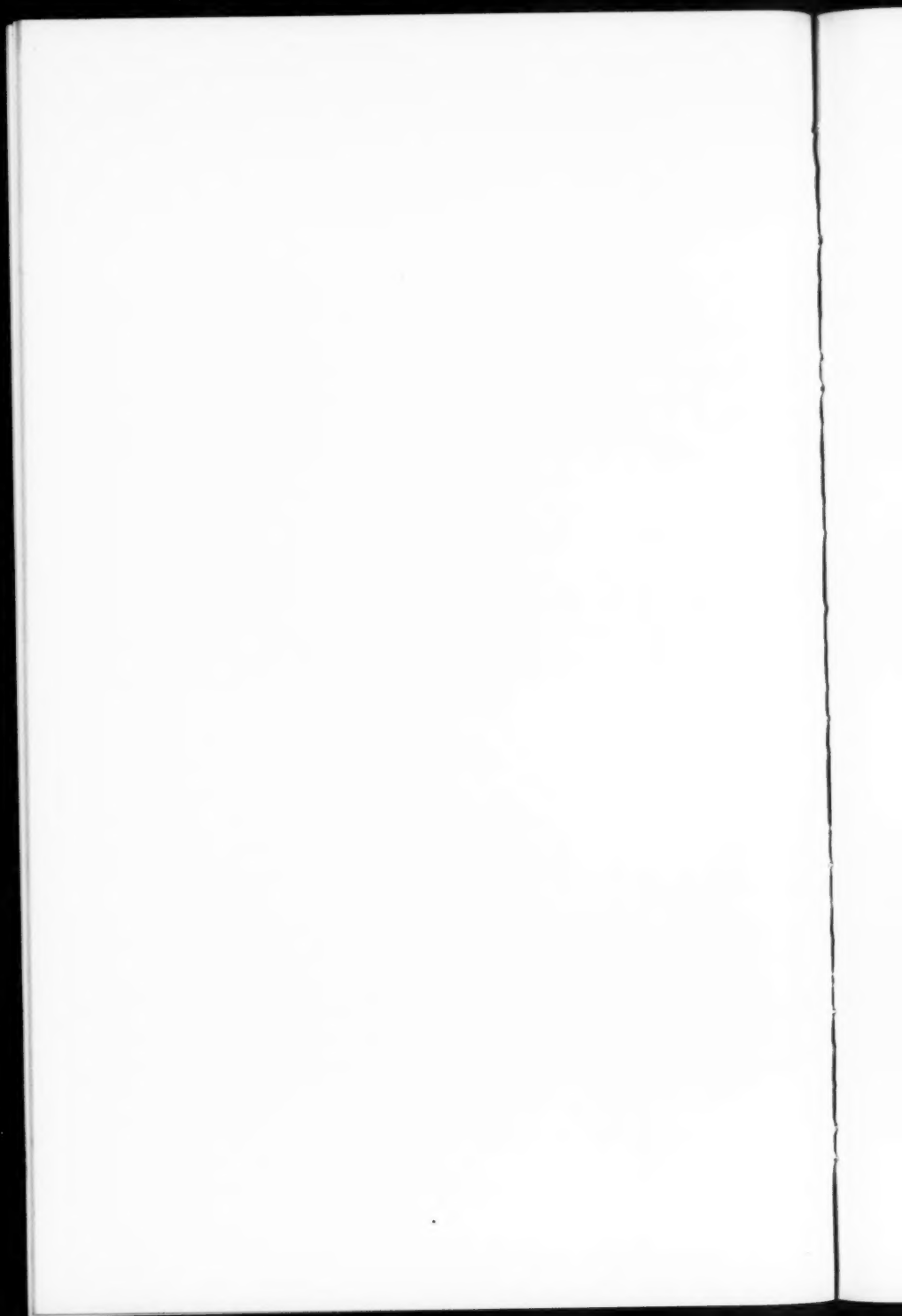
Plate 17. Upper left-hand figure. Immature or non-spore-bearing hymenium. The pores are separate and distinct. This is the form in which the hymenium is usually found. Magnified about 5 times.

Upper right-hand figure. Fully developed, sporulating hymenium, showing the daedaleoid nature of the pores and the irregularly cut, irpiciform openings. Magnified about 5 times.

Lower figure. Microphotograph of pores showing type of partitions indicative of the irregular labyrinths. Also the elongated, sterile hyphae at the partitions. Magnified about 50 times.



POLYPORUS SULPHUREUS VAR. *OVERHOLTSHII*





POLYPORUS SULPHUREUS VAR. *OVERHOLTZII*

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CRITICAL REMARKS ON CERTAIN SPECIES OF SCLEROTINIA AND MONILIA ASSOCI- ATED WITH DISEASES OF FRUITS

JOHN W. ROBERTS AND JOHN C. DUNEGAN

INTRODUCTION

The taxonomic position of certain species of *Sclerotinia* and *Monilia* which cause diseases of fruits throughout the world has been for many years in a chaotic state. A number of factors are responsible for this but as Wormald (20) points out the most important ones are the comparatively rare occurrence of the ascogenous forms in many parts of the world and the varying responses of the monilial forms to different environmental conditions. The placing of certain species of *Monilia* in the genus *Sclerotinia* before the discovery of their sclerotinial stages and the assumption that ascogenous forms occurring in America are related to monilial forms occurring in Europe are additional factors.

The status of the various species has become so obscured by contradictory statements that the authors have proposed the following dicta as a guide in the study of the validity of the species.

1. Names of species to be valid must be accompanied by adequate descriptions, properly published.

2. Assumptions that species of *Monilia* have species of *Sclerotinia* as ascogenous stages are permissible but scientific names based on unknown ascogenous forms are not valid.

3. Whenever possible the connection between the species of *Sclerotinia* and the species of *Monilia* must be demonstrated if it is to be accepted.

The writers feel that these dicta involve no departure from the established rules of procedure universally recognized.

HISTORICAL REVIEW

For many years European pathologists believed that there was only one species of *Monilia* attacking fruits in Europe,

namely, the *Monilia fructigena* of Persoon (9, 10). In 1851 Bonorden (3) had described another under the name *Monilia cinerea*, but the distinction between the two species was long in question. In 1900, however, Woronin (22) demonstrated that the *Monilia fructigena* of Persoon and the *Monilia cinerea* of Bonorden are distinct species.

A similar state of affairs existed in America where the common brown-rot fungus was considered to be *Monilia fructigena* although Smith in 1889 (17) had noted that its conidial tufts were ash-gray rather than buff. Aderhold and Ruhland (1) stated in 1905 that the American form was not *Monilia fructigena* but *Monilia cinerea*. As the result of extensive cultural work by Matheny (6) and others employing European and American material it became evident that the American form closely resembled *Monilia cinerea* of Europe. No form resembling *Monilia fructigena* was found nor has such a form been reported in America up to the present time.

In 1923 Barss (2) stated that in addition to the common form prevalent in the United States there is another *Monilia* present in Oregon which attacks the blossoms, spurs and twigs of stone fruits and certain varieties of pears but produces little fruit-rot. This fungus had been mentioned by Jackson (5) as early as 1915 and later was investigated by Posey (12) whose main study has not been published. On artificial media the fungus showed decided differences when compared with the more common form. Barss (2) named it *Monilia oregonensis* Barss and Posey, with a statement that a formal description had been submitted for publication. The formal description has not appeared and *Monilia oregonensis* must be considered a *nomen nudum*. Rudolph (15) later described a blossom blight of apricots in California caused by apparently the same fungus. Ezekiel (4) in 1925 comparing material received from Barss and from Rudolph with the true *Monilia cinerea* of Europe came to the conclusion that the *Monilia oregonensis* of Barss and Posey occurring in Oregon and California agrees in all details with *Monilia cinerea* and that the two should probably be considered identical. He writes: "*Monilia oregonensis* Barss and Posey agrees morphologically, culturally and in its life

history with *S. cinerea*, and is doubtless to be considered synonymous." Since the apothecial stage of the Oregon fungus has not yet been found, it is evident that the agreement was with the monilial stage of *Sclerotinia cinerea*, i.e., *Monilia cinerea*.

In 1888 Woronin (21) demonstrated the connection between a species of *Monilia* and a species of *Sclerotinia* occurring on *Vaccinium vitis-idaea*. This was the first time a connection between species of these genera had been demonstrated and furnished the basis for the assumption made by Schröter (16) in 1893 that *Monilia fructigena* and *Monilia cinerea* are conidial forms of *Sclerotinia*. He therefore proposed the names *Sclerotinia fructigena* and *Sclerotinia cinerea* for the two species, the apothecial stages of which were at that time unknown.

In 1902 Norton (7) found apothecia of a species of *Sclerotinia* developing from peach mummies and demonstrated their connection with the common *Monilia* of stone fruits. Assuming the species of *Monilia* common in America to be identical with *Monilia fructigena* of Europe, he named the fungus *Sclerotinia fructigena*.

In 1905 Aderhold and Ruhland (1) announced the discovery of a species of *Sclerotinia* which they demonstrated through ascospore cultures to be connected with *Monilia fructigena*. In the same paper they described *Sclerotinia cinerea* basing the description of the apothecial stage on preserved American specimens sent them by Norton and that of the conidial stage on material collected by them in Europe. Since they were of the opinion, as previously pointed out, that the imperfect stage of the American brown-rot fungus was the same as *Monilia cinerea* of Europe, they considered Norton to be in error in calling his fungus *Sclerotinia fructigena*. This view was supported by the results of investigations by Matheny (6) and others.

In 1919 Wormald (19) pointed out that both *Monilia fructigena* and *Monilia cinerea* occur in England and that *Monilia cinerea* includes two biological forms which he designated as forma *Mali* and forma *Pruni*. These forms he recognized as the result of inoculation experiments on apple blossoms. In 1920 he (19) further demonstrated that these biological forms could

be distinguished in the laboratory by differences in enzyme production and that the behavior of the American *Monilia* resembled more closely that of forma *Mali* than that of forma *Pruni*. He also observed differences in the manner of growth of the European *Monilia cinerea* and that of the American *Monilia* on artificial media and differences in the lengths of their germ tubes before branching. With these differences in mind he regarded the American form as distinct, provisionally referring to it as *Monilia cinerea* forma *americana*.

Less than a year later the same author (20) reported the discovery of a species of *Sclerotinia* on plums in England which he showed to be the perfect stage of *Monilia cinerea* Bon. Since this was the perfect stage predicated by Schröter, he accepted the name *Sclerotinia cinerea* (Bon.) Schröter for it and presented a somewhat detailed discussion of its morphological characters.

In December 1923 at the Cincinnati Meeting of the American Phytopathological Society, Norton & Ezekiel (8) stated that as a result of their studies they had not only confirmed Wormald's findings as to differences between the European and American imperfect forms but felt that the American was sufficiently distinct from the European to warrant specific rank. They proposed the name *Sclerotinia americana* (Wormald) comb. nov. for the American form and stated: "This is the fungus widely destructive in this country, whose apothecial stage was described by Norton, and which was studied and described by Reade, Matheny, etc."

As early as 1909 Pollock (11) called attention to Winter's description of the fungus *Ciboria fruticola* Winter, a name which Saccardo later changed to *Sclerotinia fruticola* on the authority of Rehm. Pollock asserted that here was a valid description of a species of *Sclerotinia* which Rau found on peach mummies at Bethlehem, Pennsylvania in 1883 and which was probably the perfect stage of our common brown-rot fungus. Through the cooperation of Dr. C. L. Shear, the authors in 1923 obtained from Mr. Eugene Rau material of the original collection part of which he had sent to Winter in 1883. Studies of this material published elsewhere (14) indicated the identity of this cotype material of *Sclerotinia fruticola* with the ascog-

enous stage of the American brown-rot fungus as it appears today.

DISCUSSION

Having enumerated the various names applied to certain species of *Monilia* and *Sclerotinia* occurring in Europe and America, it will be interesting to consider their validity with reference to the dicta previously laid down.

The names *Monilia fructigena* and *Monilia cinerea* established by Persoon and by Bonorden respectively are obviously valid as they cover species shown by many investigators to be distinct and were properly published with adequate descriptions.

Schröter's new combinations *Sclerotinia fructigena* and *Sclerotinia cinerea* published in 1893 can not be considered valid as they were based only on the assumption that species of *Monilia* would have species of *Sclerotinia* for their perfect stages. Of *Sclerotinia fructigena*, Schröter writes "Schlauchfrucht unbekannt" and of *Sclerotinia cinerea* "Nur Conidienfrüchte bekannt." In reality his descriptions are only redescriptions of the *Monilia fructigena* and *Monilia cinerea* already described by Persoon and Bonorden respectively.

Winter's description in 1883 of the ascomycete which he named *Ciboria fructicola* and which Saccardo later changed to *Sclerotinia fructicola* is a valid description of a *Sclerotinia* arising from peach mummies and which is almost certainly identical with the species commonly found on peach mummies today. Unfortunately, at that time, the connection between this form and the species of *Monilia* rotting the fruits was not recognized. However, apothecia of the cotype material collected by Rau in 1883 appear to be morphologically identical with those which are commonly found today and which are known to be connected with the *Monilia* causing the common rot of peaches. The belief in the identity of *Sclerotinia fructicola* with the common species of today is further supported by the fact that the month of May is the time of the year when in the latitude of Bethlehem, Pennsylvania, the sclerotia on mummied fruits are producing apothecia. In a previous publication on this subject the authors stated (14): "It seems certain that in 1883 Rau collected and Winter described the species of *Sclerotinia* which Norton in 1902

showed to be the ascogenous stage of our common brown-rot fungus."

It was not until 1902 when Norton rediscovered the apothecial stage that the connection between the *Monilia* and a species of *Sclerotinia* in America was established. Norton thought the fungus to be the *Sclerotinia fructigena* predicated by Schröter and accordingly gave it that name. The ascospores gave rise to the common species of *Monilia*, which Norton like other American investigators assumed to be identical with *Monilia fructigena* of Europe.

Aderhold and Ruhland in 1905 established the name *Sclerotinia fructigena* on valid grounds. By means of cultures they demonstrated that ascospores from the apothecia, which they had discovered, gave rise to a typical growth of *Monilia fructigena*. The status of their species, *Sclerotinia cinerea*, is somewhat different. Believing the American fungus not to be *Sclerotinia fructigena* as claimed by Norton but the *Sclerotinia cinerea* of Schröter, they presented a formal scientific description using preserved material received from Norton as a basis for the apothecial description and fresh European material of *Monilia cinerea* for the conidial. This procedure was perfectly logical from their viewpoint, but as will be shown later there is now strong evidence for believing that *Monilia cinerea* of Europe is not the same species as the common American fungus. Wormald (20) apparently believed them not to be identical for he states "Aderhold and Ruhland's assumption that the American *Sclerotinia* is a stage in the life-history of the European *Monilia cinerea* Bon. is untenable." If, as there are good reasons for believing, the two are not identical, Aderhold and Ruhland's description cannot be considered valid.

In 1921 Wormald in England found and described apothecia on plum mummies and, after demonstrating their connection with *Monilia cinerea*, he termed the fungus *Sclerotinia cinerea* (Bon.) Schröter, thus validating that name.

In 1923 Norton and Ezekiel proposed a new name for the American fungus, i.e., *Sclerotinia americana*, feeling that it was sufficiently distinct from European forms to warrant specific rank. In 1924 the authors after showing that the cotype

material of *Sclerotinia fructicola* is morphologically identical with the species of *Sclerotinia* commonly occurring on mummied fruits called attention to the fact that if the American fungus is considered a distinct species the name *Sclerotinia fructicola* has priority over other names. The following year Ezekiel (4) stated: "If means of distinguishing *S. americana* from *S. cinerea* by the apothecial characteristics should be worked out, we might then be able to identify the dried specimens of Winter more definitely with *S. americana*, which would then properly be called *S. fructicola*. For the present, it seems preferable to use Wormald's name *americana*, which was published with the first description that differentiated the American species from the earlier known European forms." The authors fail to agree with Ezekiel's reasoning. They do not feel that the problem of distinguishing between apothecia of *Sclerotinia cinerea* of Europe and the apothecia of the common American form has anything to do with the problem of the identity of the latter with Rau's material of *Sclerotinia fructicola*. They are two separate and distinct problems. The writers' (14) studies have shown that the apothecial characters of *Sclerotinia fructicola* agree very well with those of the species of *Sclerotinia* commonly found on mummied peaches in America at the present time. Finally if one believes that the imperfect stages of the European form and the American form are different enough to consider them distinct species, then surely he should consider that the perfect stages are distinct or admit the apparent absurdity that an apothecial form can give rise to two distinct monilial forms each one worthy of specific rank. If the American fungus is considered a species distinct from the European and is admitted to be identical with the species of *Sclerotinia* found by Rau, then there is no escape from the priority of the name *Sclerotinia fructicola*.

At the time the authors published their account of *Sclerotinia fructicola* they were aware of certain differences between *Monilia cinerea* of Europe and the common *Monilia* of America. These differences were physiological rather than morphological in character or were not pronounced enough to convince the writers that without additional evidence the two forms should be

regarded as distinct species. The copious production of conidial masses on the spurs and twigs by the European form and the comparative rarity of such production by the American form they felt might possibly be due to differences in environmental conditions and believed that possibly the American form if introduced into Europe might respond in a fashion similar to the European form. Differences in the mode of branching of the germ tubes as first pointed out by Wormald were recognized, but the use of this as a major diagnostic character would preclude the identification of nonliving material. One other feature, namely the rare occurrence of apothecia in the European form as contrasted with the American form, was recognized and was considered as possibly the result of environmental conditions. However, the discussion, by Barss (2), of the Oregon fungus sheds considerable light on the problem. Here was a demonstration, under environmental conditions very similar to those of Europe, of the behavior of the common American form and of another fungus which, as shown by Ezekiel (4), agrees both morphologically and in its physiological behavior with *Monilia cinerea* of Europe. The differences in the physiological behavior were apparently uninfluenced by the environmental conditions. The common American form continued to attack blossoms, rot the fruit, and produce apothecia abundantly but the other form was mainly a spur and blossom inhabiting form producing conidia late in the winter or early spring with only a negligible amount of fruit-rot. Barss (2) states: "In tests it [the Oregon form] failed to produce the apothecial (spore-cup) stage under conditions that gave abundant development of this stage with the ordinary brown-rot fungus. It produces spores in chains very closely resembling those of ordinary brown-rot, but it differs from the latter in the appearance and manner of spore production on the host plant."

The authors have specimens of the Pacific Coast fungus which were sent them by Mr. B. A. Rudolph, of the California Agricultural Experiment Station. The specimens consist of apricot twigs showing compact tufts or pads of hyphae and conidiophores on or about the bases of the old fruit stems. The tufts or pads are ashen gray and, being a millimeter or more across, are easily

visible to the naked eye. They are not easily rubbed off and persist in dried material. No such tufts or pads are found on twigs invaded by the common brown-rot fungus, the nearest approach to them being the delicately fragile tufts of conidial chains which, being easily dislodged, are seldom found in dried specimens. Cultural work performed by the authors confirms that of Barss (2) and of Ezekiel (4).

A consideration of all these facts leads the authors to recede from the position taken in their previous paper, *i.e.*, that they preferred to retain *Sclerotinia cinerea* as the name for the fungus causing the common fruit-rot in America. The physiological differences which they hesitated to accept as criteria for the separation of the species have been shown to persist when the two species occur naturally under environmental conditions similar to those of Europe. Moreover, it is possible to separate the two in the orchard or in herbaria. Even if the Oregon form is later shown not to be identical with *Monilia cinerea* of Europe, it is much more closely related to that form than is the common American form. Accordingly the authors feel that the common American brown-rot fungus is to be considered a distinct species. Its name should be *Sclerotinia fructicola*, the first name applied to it and one accompanied by an adequate description.

A formal scientific description of both the perfect and imperfect forms was published by Reade (13). Although he wrongfully used the name *Sclerotinia fructigena*, his description is an excellent one and is the only one known to the authors that includes both stages.

SUMMARY

The taxonomic position of certain species of *Sclerotinia* and *Monilia* which cause disease of fruits has for many years been in a chaotic state. In order to correct this confusion the following dicta are proposed.

1. Names of species to be valid must be accompanied by adequate descriptions, properly published.
2. Assumptions that species of *Monilia* have species of *Sclerotinia* as ascogenous stages are permissible but scientific names based on unknown ascogenous forms are not valid.

3. Whenever possible the connection between a species of *Sclerotinia* and a species of *Monilia* must be demonstrated, if it is to be accepted.

With these dicta as a guide a critical review of the literature and their own studies lead the authors to conclude:

1. Two species occur on drupaceous and pomaceous fruits in America, one being the common brown-rot fungus and the other a recently discovered form occurring along the Pacific Coast.

2. The common form the writers now believe to be a species distinct from any known European form.

3. The correct name of the common form is *Sclerotinia fructicola* (Wint.) Rehm.

4. The Pacific Coast form is similar to and possibly identical with *Monilia cinerea* of Europe. No perfect stage of this fungus has been found in this country.

5. *Sclerotinia fructigena* is a valid name for a fungus occurring in Europe but not known to occur in the United States.

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NEW SPECIES OF LICHENS FROM PORTO RICO—I. GRAPHIDACEAE

BRUCE FINK

GENERAL INTRODUCTION

For more than a quarter of a century various American botanists, for the most part connected with The New York Botanical Garden, have been collecting lichens in Porto Rico. The writer began determining the *Graphidaceae* collected by these workers in Porto Rico and on adjacent islands in 1911 and his studies of Porto Rican and other tropical lichens have continued to the present time. In November, 1915, he went to Porto Rico for the purpose of becoming acquainted with the lichen flora in general and the *Graphidaceae* in particular.

While the writer was working on the family treated in this contribution the late Dr. L. W. Riddle was making a study of lichens collected during expeditions from The New York Botanical Garden to several tropical islands, including Porto Rico. In this investigation Doctor Riddle determined about 300 specimens from Porto Rico and the Virgin Islands, covering more than 100 species. More recently the writer extended his work to cover all of the collections made from The New York Botanical Garden and this work is still going forward. During this time he has also determined the collections made in Porto Rico by Dr. F. L. Stevens.

The writer's collection of Porto Rican fungi reached approximately 2300 numbers, of which somewhat more than two thirds were lichens. For several years the writer gave his time to studies of the *Graphidaceae*. During this time Mr. G. K. Merrill determined 500 specimens of the Porto Rican collection from many families and genera. At the same time Doctor Riddle determined about 40 specimens from the *Arthoniaceae*. Mr. Ludwig Scriba and Mr. Henri Sandstede handled the rather small collection of *Cladoniae*. This left for the writer approximately 1000 specimens for study. Finally he submitted nearly

150 numbers from the most difficult and critical material to our greatest lichenists, Dr. E. A. Vainio and Dr. A. Zahlbruckner.

The literature of tropical lichens is very incomplete and fragmentary and much of it not easily accessible. Moreover no American lichenist had studied tropical lichens seriously when work was demanded by the collections being made. Consequently the studies have been accomplished with large expenditure of energy, covering many years. As will appear from statements above several lichenists had part in the work, and it is the result of circumstances that the writer is now engaged in bringing the studies to a conclusion.

The writer's herbarium has been greatly enriched during the fifteen years of work on tropical lichens. Practically all of the species collected are represented by one or more specimens, including types or cotypes of all the new species. The writer is adding to the rich collection of tropical lichens in the herbarium of The New York Botanical Garden a nearly complete set of his own collections. Also he is placing as nearly complete sets as possible in the Farlow Herbarium of Harvard University and in the National Herbarium at Washington. Mr. G. K. Merrill is considered next, and after him Professor C. C. Plitt and Mr. S. Rapp.

A large amount of work would be required yet for an approximately complete study of the lichen flora of Porto Rico and adjacent islands. In this connection it is in order to state that a few days of collecting in the region about Yauco indicates plainly that the desert regions of Porto Rico are unique with respect to lichen flora and worthy of very careful study. In this region the lichens are mainly crustose species and one might easily fail to see them and gain the impression that there were few lichens. The present paper, which deals exclusively with new species of obscure, crustose lichens, gives a forecast of the rewards that would result from exhaustive collecting and study of the lichens of the desert regions of Porto Rico. Other papers of this series will furnish even better evidence.

THE GRAPHIDACEAE

It is now 17 years since the writer began studying the *Graphidaceae* of North America. Twelve years ago he went to Porto

Rico and collected the *Graphidaceae* carefully. During the fifteen years of work the literature of the family has been studied carefully and material has been examined in the large American collections and from specimens sent for study by some of the best collectors. Also tropical species preserved in the Herbar Boissier and the species of *Graphis* in the herbarium of the Naturhistorisches Hofmuseum at Vienna were loaned to the writer for study. The *Graphidaceae* comprise a large and difficult group of more than 1000 species, about one third of which are known in tropical America. Few of our tropical areas have been studied carefully and in none of them have all the new species been discovered, due mainly to the fact that these fungi are among the most inconspicuous lichens and are, consequently, overlooked in general collecting.

The thallus of members of the *Graphidaceae* is uniformly crustose without plectenchymatous cortex. Besides the superficial crustose portion the hyphae penetrate into the substratum, where they form a network. The algal host is usually *Trentepohlia* (*Chroolepus*) as is uniformly the case in the species described herein. *Palmella* is the host in a comparatively small number of genera, which furnished no new species in the writer's collecting in Porto Rico. The algae are almost exclusively within the substratum. The apothecia are usually elongated and more or less branched. In some species they are round to slightly elongated or irregular. The exciple is usually well developed, varying in color from brown to more commonly black or at least blackish. In some instances it is poorly developed, and much lighter colored. The disk is closed and indicated by a depressed line, or more or less open and commonly black or variously pruinose. The hypothecium varies from hyaline to dark brown or nearly black. The hymenium is uniformly hyaline. The paraphyses are hyaline and non-septate. They are roughly parallel and unbranched or interwoven and branched, and usually become gelatinized and sometimes indistinct. The asci are most commonly clavate but may vary markedly from this form. The spores are transversely septate or both transversely and longitudinally septate (muriform) in the species described herein, though in a few species they are non-septate.

The new species from Porto Rico follow, arranged by genera. The types are in the writer's herbarium.

OPEGRAPHA Humb.

1. *Opegrapha dirinicola* n. sp.

Thallus imbedded in the tissues of the host and invisible; apothecia minute, $0.3-0.7 \times 0.1-0.2$ mm., immersed to semi-superficial, straight to rarely somewhat curved, the disk closed and usually indicated by an obscure, depressed, black line, the exciple black; hypothecium dark brown; hymenium hyaline; paraphyses hyaline, distinct, interwoven, and sparingly branched; asci clavate to broadly clavate, the wall not much thickened in the apical region; spores 8, dactyloid, hyaline or tinged with brown, 3-septate, the cells cylindric, $12-16 \times 5-6 \mu$, irregularly arranged.

Parasitic on *Dirina Ceratoniae* on bark in an open field near Mayaguez, Fink 1181a. Supposed to bear a parasitic relation with *Trentepohlia*, the algal host of *Dirina*, on which the new species grows.

2. *Opegrapha minutula* n. sp.

Thallus thin, smooth, ashy gray to whitish; apothecia minute, round to slightly elongated or irregular, 0.15-0.2 mm. across or reaching 0.3 mm. in one direction, partly immersed to adnate, the disk closed or opening slightly and indicated by an obscure, depressed, blackish line, sometimes branching one or more times at various angles from near the center, the exciple black and of moderate thickness; hypothecium thinner and dark brown; hymenium hyaline; paraphyses hyaline, interwoven, and branched, distinct to semi-distinct; asci clavate, the wall not much thickened in the apical region; spores 8, long-oblong, 3-septate, the cells cylindric, hyaline or finally brownish, $18-26 \times 5-6 \mu$, biserially to irregularly arranged.

On bark in an open field near Rio Piedras, Fink 492.

3. *Opegrapha alboatra* n. sp.

Thallus thin, smooth, ashy white, often absent superficially and indicated by surface coloration of the substratum; apothecia minute to small, irregular and 0.2-0.35 mm. across or more often elongated and reaching 0.5-1.5 mm. in one direction, when straight to curved, adnate and often clustered, the disk and the exciple black, the former becoming more or less open and

concave; hypothecium brown; hymenium hyaline; paraphyses hyaline, interwoven and branched, becoming indistinct; asci ovoid-clavate, the wall much thickened in the apical region; spores 8, dactyloid-elliptic, 3-septate, the cells cylindric, hyaline to finally brownish, $22-26 \times 8-10 \mu$, the wall at first thick but becoming thinner, irregularly arranged.

On rocks on a high, exposed hilltop south of Yauco, Fink 1556 and 1592 (type).

4. *Opegrapha subabnormis* n. sp.

Thallus thin, smooth to slightly rough and chinky, light greenish gray to ashy, dissected and bordered more or less by blackish lines; apothecia long but rather narrow, $0.7-4 \times 0.2-0.35$ mm., immersed to semi-superficial, straight, curved or flexuous, rarely branched, the disk closed to open and blackish, or grayish pruinose, the exciple dirty black, surrounded by a whitish, thalloid one; hypothecium brown; hymenium hyaline; paraphyses hyaline, distinct, interwoven, and branched; asci clavate, the wall not much thickened in the apical region; spores 8, hyaline, elliptic, 3-septate, the cells cylindric, $22-27 \times 4.5-5.5 \mu$, irregularly arranged.

On bark in an open field near Mayaguez, Fink 1245.

5. *Opegrapha albidoatra* n. sp.

Thallus thin, smooth, ashy white, becoming slightly rough, chinky and powdery, and sometimes disappearing superficially; apothecia becoming moderately long but narrow, $1-3 \times 0.2-0.3$ mm., numerous and often clustered, partly immersed to adnate, variously curved or flexuous, very rarely branched, the disk closed to more or less open, when whitish pruinose, the exciple black, moderately thick, sometimes covered more or less laterally by a whitish, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, interwoven, and branched, distinct to semi-distinct; asci clavate, the wall not much thickened in the apical region; spores 8, oblong-elliptic, hyaline to finally brownish, 4-7-septate, the cells cylindric, $14-18 \times 3-4 \mu$, irregularly arranged.

On bark in various habitats near Naranjito, Fink 142 and 298, near Rio Piedras, Fink 506 (type) and 513.

6. *Opegrapha riopiedrensis* n. sp.

Thallus thin, smooth, ashy white; apothecia long and narrow, $1-4 \times 0.2-0.3$ mm., semi-superficial, curved or flexuous, often

branched, sometimes radiately, the disk soon open, flat, dull black, the exciple rather thin and black; hypothecium and hymenium pale; paraphyses hyaline, branched, interwoven, and semi-distinct; asci broadly clavate, the wall not much thickened in the apical region; spores 8, long-elliptic, hyaline to finally pale brownish, 5-7-septate, the cells cylindric, $17-23 \times 4.5-5 \mu$, irregularly arranged.

On bark in an open field near Rio Piedras, Fink 507.

MELASPILEA Nyl.

1. *Melaspilea cinereoatra* n. sp.

Thallus very thin or superficially absent and the imbedded portion giving the substratum an ashy gray surface coloration; apothecia short and very narrow, $0.4-1.3 \times 0.15-0.2$ mm., superficial and scattered, straight to less frequently curved, very rarely branched, the disk closed and indicated by an inconspicuous, depressed, black line, the black exciple moderately thick; hypothecium rather thick, brownish black; hymenium pale; paraphyses hyaline, unbranched, distinct to finally indistinct; asci oblong-clavate, becoming somewhat ventricose, the wall scarcely thickened in the apical region; spores 8, oblong, hyaline to pale brown, 1-septate with one cell slightly larger, $22-24 \times 7.5-8.5 \mu$, irregularly arranged.

On bark on a high, dry hilltop near Yauco, Fink 1475.

2. *Melaspilea cryptothallina* n. sp.

Thallus wholly imbedded in the substratum and showing at the surface as an ashy gray coloration; apothecia short and very narrow, $0.4-1.6 \times 0.1-0.15$ mm., adnate, commonly scattered, straight to curved or obscurely flexuous, rarely branched, the disk closed and sometimes indicated by a depressed, black line, the exciple thin and black; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, becoming indistinct; asci clavate, the wall scarcely thickened in the apical region; spores 8, oblong, 1-septate with one cell usually larger, passing from hyaline to pale brown, $15-17 \times 7-8 \mu$, irregularly arranged.

On bark on a hilltop near Yauco, Fink 1557, and in a wood near Manati, Fink 2056 (type). Algal host infrequently seen with the lichen hyphae within the substratum.

3. *Melaspilea fuscolimitata* n. sp.

Thallus imbedded in the substratum and indicated at the surface by an olive-gray to ashy coloration and a blackish

limiting line; apothecia moderately long but narrow, $0.5\text{--}2.5 \times 0.15\text{--}0.25$ mm., adnate and often clustered, straight to curved or flexuous, infrequently once to several times branched, the disk closed and indicated by an obscure, depressed, black line, the exciple black and moderately thick; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, and semi-distinct; asci clavate, with the wall slightly thickened in the apical region; spores 8, oblong, 1-septate, constricted with one cell larger, hyaline to finally brown, $12\text{--}16 \times 6\text{--}8$ μ , irregularly arranged.

On bark on a high, exposed hilltop near Yauco, Fink 1480 (type) and 1622.

4. *Melaspilea subolivacea* n. sp.

Thallus imbedded in the substratum and showing at the surface as a dull olive-brown coloration; apothecia short to long but narrow, $1\text{--}4 \times 0.15\text{--}0.3$ mm., adnate and scattered, straight to curved or rarely and obscurely flexuous, very infrequently branched, the disk closed and indicated by a depressed, black line, or more or less open and brownish black or slightly tinged with red, the exciple black, of moderate thickness; hypothecium and hymenium pale, the former often subtended by a blackish portion of the perithecial wall; paraphyses hyaline, unbranched, and semi-distinct; asci clavate, the wall but little thickened in the apical region; spores 8, soon pale brown, oblong, 1-septate, constricted, with one cell usually larger, $23\text{--}27 \times 10\text{--}12$ μ , irregularly arranged.

On bark in a wood near Aibonito, Fink 1810. Algal host occasionally seen with the lichen hyphae.

5. *Melaspilea subrimalis* n. sp.

Thallus thin and smooth, light greenish gray to yellowish ashy, the superficial portion often absent; apothecia long and narrow, $1\text{--}4 \times 0.15\text{--}0.3$ mm., adnate, numerous and often clustered, straight to variously curved, very rarely branched, the disk closed to narrowly open and black, the exciple of the same color and moderately thick; hypothecium blackish brown; hymenium hyaline or pale; paraphyses hyaline, distinct, and unbranched; asci oblong-clavate, with the wall slightly thickened in the apical region; spores 8, oblong, 1-septate, slightly constricted, with cells equal, hyaline to finally dark brown, $15\text{--}19 \times 7\text{--}9$ μ , irregularly arranged.

On bark in an open field near Manati, Fink 2035.

GRAPHIS Adans.

1. *Graphis dumastioides* n. sp.

Thallus thin, smooth, pale olive-brown, varying toward greenish gray; apothecia short and narrow, $0.5-2 \times 0.15-0.25$ mm., immersed, unbranched, straight to curved, the disk closed and finally indicated by a raised to depressed, dark line, the exciple pale and rudimentary, covered by a light colored, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci cylindroclavate, the wall only moderately thickened in the apical region; spores 8, hyaline, oblong-elliptic, 3-septate, the cells lenticular, $14-18 \times 6-8 \mu$, obliquely uniseriate.

On bark in a wood near Mameyes, Fink 723.

2. *Graphis rimulosa lignicola* n. subsp.

Thallus thin, smooth, ashy white; apothecia becoming long and wide, $1-7 \times 0.3-0.4$ mm., immersed to semi-superficial, unbranched, mostly straight and roughly parallel, the last two constituting the distinctive subspecific characters, the disk closed and indicated by a depressed, black line, the exciple black and becoming two or three times longitudinally striate; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci broadly clavate, plainly thickened in the apical region; spores reaching 8, hyaline, long-elliptic, 9-14-septate, the cells lenticular, $30-40 \times 6.5-8.5 \mu$, irregularly arranged.

On decorticated wood in an open field near Aibonito, Fink 1873.

3. *Graphis yaucoensis* n. sp.

Thallus rather thin, smooth, ashy gray, becoming sparingly chinky; apothecia very long and very narrow, $2-8 \times 0.12-0.18$ mm., partly immersed, soon and often strongly curved or flexuous, very rarely branched, the disk closed to narrowly open, indicated by a black line or showing a narrow or wider, grayish, flat surface, the exciple brownish black, moderately thick, surrounded more or less by a thin, ashy gray, thalloid one; hypothecium pale to darker brown, sometimes tinged with red; hymenium hyaline; paraphyses hyaline, semi-distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, long-elliptic, 5-9-septate, the cells lenticular, $26-32 \times 5.5-6.5 \mu$, irregularly arranged.

On bark in a wood near Yauco, Fink 1691.

4. *Graphis albida* n. sp.

Thallus rather thin, smooth to slightly rough, grayish white or tinged with yellow; apothecia long and wide, $1-4 \times 0.3-0.4$ mm., partly immersed to adnate, and completely covered by a thin, whitish, thalloid veil, straight to curved or flexuous, infrequently once to five times branched, in the several-branched conditions often more or less plainly radiate, the disk closed and indicated by a dark line when moistened, the exciple and the hypothecium brownish black; hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall but slightly thickened in the apical region; spores reaching 8, hyaline, elliptic, 3-7- but usually 5-septate, cells lenticular and the end cells larger, $16-28 \times 7.5-10 \mu$, irregularly arranged.

On bark in an open field near Aibonito, Fink 1777.

5. *Graphis immersa* n. sp.

Thallus of moderate thickness, smooth, ashy white; apothecia becoming long but remaining narrow, $1-4 \times 0.2-0.25$ mm., immersed to slightly raised, straight to curved or flexuous, infrequently once branched, the disk closed and indicated by an obscure, depressed, black line, the exciple black, thickish and once or twice obscurely striate longitudinally, when raised bordered more or less by a whitish, thalloid one; hypothecium thick and brownish black; hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate to broadly clavate, the wall much thickened in the apical region; spores 8, hyaline, long-elliptic, 7-13-septate, the cells lenticular, $22-45 \times 7.5-8.5 \mu$, irregularly arranged.

On bark on a high, exposed hilltop near Yauco, Fink 1613.

6. *Graphis tumidulella* n. sp.

Thallus of moderate thickness, smooth to slightly rough, becoming obscurely chinky, pale greenish gray to ashy; apothecia long and rather narrow, $1.5-7 \times 0.25-0.35$ mm., slightly immersed to adnate, more or less curved or flexuous, very rarely branched, the disk closed and indicated by a depressed, dull black line, or narrowly open and black, the exciple thin above to thick below, black and covered by a strongly developed, whitish, thalloid one; hypothecium brownish black; hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, long-elliptic, 9-12-septate, the cells lenticular, $35-53 \times 7-9 \mu$, irregularly arranged.

On bark in a wood near Aibonito, Fink 1737 (type). Also in the foothills of El Yunque, Percy Wilson 19, collected in 1902.

PHAEOGRAPHIS Müll. Arg.

1. *Phaeographis sexloculata* n. sp.

Thallus thin or entirely within the substratum and indicated by an ashy to olivaceous coloration; apothecia long but remaining very narrow, $1-3.5 \times 0.15-0.2$ mm., partly immersed, usually curved or flexuous, unbranched, the disk closed and indicated by a depressed, blackish line, the exciple black and rather thin; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, becoming indistinct in the finally granular matrix; asci clavate, the walls moderately thickened in the apical region; spores 8, oblong, pale to darker brown, 5-septate, the cells lenticular, $22-26 \times 8-9 \mu$, irregularly arranged.

On bark on an exposed hilltop near Yauco, Fink 1436.

2. *Phaeographis inustoides* n. sp.

Thallus rather thin and smooth, pale greenish gray to whitish; apothecia round to short and wide, 0.3-0.6 mm. across, or elongated in one direction to 1.5 mm. and straight to curved, wholly immersed, the disk open and black, slightly concave to flat, the exciple thin and dark brown, surrounded by a thin, whitish, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, unbranched, becoming indistinct; asci clavate, the wall more or less thickened in the apical region; spores 8, hyaline to brown, oblong to oblong-elliptic, or acute toward one end and larger and rounded toward the other, 5-, rarely 7-septate, the cells lenticular, $19-22 \times 7-9 \mu$, irregularly arranged.

On bark on dry slopes near Cabo Rojo, A. A. Heller 4430 (type), collected in 1900. Also collected by Heller near Bayamon, 1251 and 1252, in 1899, and near Vega Baja, 1329, in 1900.

GRAPHINA Müll. Arg.

1. *Graphina aibonitensis* n. sp.

Thallus thin, smooth, light greenish gray to ashy; apothecia becoming very long but remaining narrow, $1-10 \times 0.18-0.3$ mm., immersed to semi-superficial, numerous and irregularly or radiately arranged, commonly curved or flexuous, the short ones unbranched, the longer ones once to several times branched, the radial arrangement seen toward the margins of thalli, the

disk soon open and brown or obscurely whitish pruinose, the exciple rudimentary, thin and brownish, covered by a well-developed, ashy, thalloid one; hypothecium hyaline to brownish; hymenium hyaline; paraphyses hyaline, semi-distinct, and unbranched; asci cylindroclavate to clavate, the wall moderately thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 3-5-septate transversely and 1-septate longitudinally toward the center, $10-12 \times 4-5 \mu$, uniseriately to irregularly arranged.

On bark in an open wood near Aibonito, Fink 1998 and 2017 (type).

2. *Graphina cinerea* n. sp.

Thallus thin, smooth, pale greenish gray to ashy; apothecia long and very narrow, $1-4 \times 0.1-0.15$ mm., immersed, becoming strongly curved or flexuous, once to three or more times branched, the disk and the exciple covered by a thalloid veil, the former closed and indicated by a thin, black line when moistened, the latter thin, brownish and sometimes not distinguishable; hypothecium and hymenium hyaline, or the former tinged with brown; paraphyses hyaline, semi-distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, elliptic, muriform, 3- more commonly 5-septate transversely and becoming 1-2-septate longitudinally, $13-16 \times 5-6 \mu$, irregularly arranged.

On bark in an open field near Mayaguez, Fink 1163.

3. *Graphina olivaceoalbida* n. sp.

Thallus thin and smooth, dull olive-colored, except for the whitish areas covering the apothecia, the superficial portion sometimes disappearing; apothecia moderately long but narrow, $1-3 \times 0.2-0.3$ mm., partly immersed to adnate, unbranched, straight to slightly curved, the disk closed and indicated by a dark line or more or less open, depressed, and pale brownish, the exciple thin and rudimentary, pale toward the base and brownish above; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 4 or more, hyaline, oblong-elliptic, muriform, 5-9-septate transversely and 1-2-septate longitudinally, $19-24 \times 9-10 \mu$, irregularly arranged.

On bark in a wood near Mameyes, Fink 815.

4. *Graphina olivobrunea* n. sp.

Thallus thin, smooth, light olive-brown; apothecia of moderate length and very narrow, $0.5-3.5 \times 0.08-0.12$ mm., partly

immersed, variously curved or flexuous, often once or more times branched, becoming much interwoven, the disk closed and covered by a thalloid veil to emergent and indicated by a pale brownish line, or rarely opening narrowly when concave and pale, the exciple pale brownish, thin and rudimentary, surrounded by a thin, olive-brown, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall more or less thickened in the apical region; spores 4 or more, hyaline, oblong-elliptic, muriform, 5-7-septate transversely and 1-2-septate longitudinally, $19-29 \times 8.5-10.5 \mu$, irregularly arranged.

On bark in a wood near Mayaguez, Fink 1224.

5. *Graphina sulcata* n. sp.

Thallus thin, smooth, pale greenish gray to ashy white; apothecia long and narrow, $1-5 \times 0.2-0.32$ mm., immersed to semi-superficial, straight to curved or flexuous, infrequently becoming once to two or three times branched, the disk closed and indicated by a depressed, black line, the exciple black and of moderate thickness, becoming once striate longitudinally, covered laterally by a whitish and disappearing, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall not much thickened in the apical region; spores 2-4, hyaline, oblong-ovoid, muriform, 5-7-septate transversely and 2-4-septate longitudinally, $20-30 \times 10-14 \mu$, irregularly arranged.

On bark in a wood near Rio Piedras, Fink 659.

6. *Graphina riopiedrensis* n. sp.

Thallus moderately thick, smooth or rarely and obscurely scurfy granulose, ashy gray; apothecia long and very narrow, $1-4 \times 0.15-0.2$ mm., partly immersed, variously curved or flexuous, rarely once to two or three times branched, the disk closed and indicated by a depressed, blackish line or opening narrowly when more or less concave and brownish black, the exciple thin throughout or thicker above and very thin or absent below, appearing brownish black where thicker to brown where thinner, covered laterally by an ashy gray, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate to broadly clavate, the wall much thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 7-9-septate transversely and 2-3-septate longitudinally, $17-34 \times 8-16 \mu$, irregularly arranged.

On bark in a wood near Rio Piedras, Fink 2167.

7. *Graphina nitidescentoides* n. sp.

Thallus thin, smooth, varying from ashy white to olivaceous, usually the former color about the apothecia, often disappearing above the substratum; apothecia short and narrow, $0.5-1 \times 0.17-0.23$ mm., semi-superficial, scattered or rarely clustered, straight to rarely curved, unbranched, the disk closed and indicated by an obscure, depressed line to open, concave, and dull brown, the exciple thin and brown; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 5-9-septate transversely and 1-2-septate longitudinally, $19-23 \times 7.5-8.5 \mu$, uniseriately to irregularly arranged.

On bark in a wood near Rio Piedras, Fink 521

8. *Graphina luridoolivacea* n. sp.

Thallus thick, smooth and warty, greenish gray or tinged with yellow or brown; apothecia short and very narrow, $0.5-1 \times 0.1-0.15$ mm., immersed, scattered or clustered, rarely branched, the disk closed and indicated by a yellowish line, or open, concave, and yellowish to brownish, the exciple very thin and yellowish, or disappearing; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate or enlarged below, the wall thickened in the apical region; spores 8, hyaline, oblong-elliptic, muriform, 7-9-septate transversely and 1-3-septate longitudinally, $18-27 \times 9-12 \mu$, irregularly arranged.

On bark in a wood near Rio Piedras, Fink 657.

9. *Graphina elongatoradians* n. sp.

Thallus moderately thick, smooth, ashy gray; apothecia very long and very narrow, $8-20 \times 0.12-0.2$ mm., semi-superficial, radiately arranged and subdichotomously branched, the disk closed and indicated by an obscurely depressed, blackish line, the exciple black, of medium thickness, finally becoming obscurely once striate longitudinally, covered more or less laterally by a grayish, thalloid one; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci clavate, the wall moderately thickened in the apical region; spores 4 or more, hyaline, oblong, muriform, 7-9-septate transversely and 1-3-septate longitudinally, $35-45 \times 13-15 \mu$, irregularly arranged.

On bark in an open field near Manati, Fink 2049.

10. *Graphina vestitoides* n. sp.

Thallus thin to moderately thick, smooth to minutely rough, greenish gray varying toward ashy; apothecia very long and

very wide, $2-10 \times 0.4-0.7$ mm., partly immersed, numerous but usually scattered, more or less curved or flexuous, very rarely branched, the disk closed and usually indicated by a depressed, blackish line, the exciple thick, black, plainly once or twice striate longitudinally, wholly or partly covered by a grayish, finally disappearing, thalloid one; hypothecium thick and brownish black; hymenium hyaline; paraphyses hyaline, unbranched, distinct to semi-distinct; asci large and clavate to inflated-clavate, the wall considerably thickened in the apical region; spores reaching 8, hyaline, long-elliptic, muriform toward the ends or rarely throughout, $14-27$ -septate transversely and becoming $1-2$ -septate longitudinally, $85-140 \times 12-18 \mu$, irregularly arranged, but sometimes tending toward parallel arrangement.

On bark in various habitats throughout the Island, Fink 148, 152, 215, 708, 948, 1795, 1906, and 1986 (type).

11. *Graphina platycarpa* n. sp.

Thallus moderately thick, smooth, becoming chinky to finally chinky-areolate, ashy gray to yellowish; apothecia long and very wide, $1-4 \times 0.5-1.2$ mm., partly immersed, straight to occasionally curved or obscurely flexuous, sometimes once or more times shortly branched, the disk open, flat, and black, the brownish black exciple rather thin and surrounded by a grayish to yellowish, thalloid one; hypothecium like the exciple in thickness and color; paraphyses and the whole hymenium hyaline, the former semi-distinct and unbranched; asci clavate, the wall thickened considerably in the apical region; spores 1 or rarely 2, hyaline to finally brownish, oblong to oblong-elliptic, muriform, $23-37$ -septate transversely and $5-9$ -septate longitudinally, $130-165 \times 30-36 \mu$.

On bark in a wood near Aibonito, Fink 1774.

PHAEOGRAPHINA Müll. Arg.

1. *Phaeographina asteroides* n. sp.

Thallus very thin and smooth, olivaceous or showing more or less of greenish gray in younger conditions, often disappearing above the substratum and indicated by surface coloration; apothecia becoming long and wide, $0.5-4 \times 0.18-0.45$ mm., slightly immersed to adnate, often clustered, straight to curved, commonly more or less branched, the grouping and branching often giving more or less of a stellate appearance, the disk soon open, dark brown to blackish, or whitish pruinose, the exciple

very thin, brownish black, often bordered more or less laterally by an olivaceous or lighter colored, thalloid one; hypothecium, hymenium and paraphyses hyaline, the last distinct to semi-distinct, and unbranched; asci cylindric to clavate, the wall moderately thickened in the apical region; spores 8, brown, oblong-elliptic, muriform, 4-6-septate transversely and 1-2-septate longitudinally, $23-28 \times 8-12 \mu$, uniseriately to biseriately and finally irregularly arranged.

On bark in an open field near Mayaguez, Fink 981.

2. *Phaeographina caesiopruinosella* n. sp.

Thallus very thin and smooth, light olivaceous or tinged with greenish gray in earlier conditions, the superficial portion disappearing and the thallus indicated by surface coloration; apothecia becoming moderately long and wide, $0.6-3 \times 0.25-0.45$ mm., immersed to semi-superficial, more or less curved or flexuous, numerous and closely clustered, usually once to four times branched, the disk open, flat, and grayish pruinose, the exciple thin and brown, often bordered obscurely by a grayish, thalloid one; hypothecium hyaline to brownish; hymenium hyaline; paraphyses hyaline, distinct to semi-distinct, and unbranched; asci clavate to finally saccate, the wall much thickened in the apical region; spores 8, brown, oblong to oblong-elliptic, muriform, 5-9-septate transversely and becoming 1-2-septate longitudinally, $25-45 \times 12-18 \mu$, irregularly arranged.

On bark in woods near Rio Piedras, Fink 42 and 140 (type).

3. *Phaeographina difformis* n. sp.

Thallus very thin, smooth and pale greenish gray; apothecia roundish to irregular or elongated, 0.5-0.8 mm. across or elongated in one direction to 1 or 1.4 mm., partly immersed, scattered or clustered, rarely and shortly branched, the disk open and brownish black, the exciple thin and of the same color, covered wholly or in part by a greenish gray, thalloid one; hypothecium thin and dark brown; hymenium hyaline; paraphyses hyaline, unbranched, imbedded in a granular matrix and semi-distinct; asci becoming broadly clavate, the wall considerably thickened in the apical region; spores 8, brown, oblong-elliptic, muriform, 7-11-septate transversely and 1-2-septate longitudinally, $30-48 \times 10-15 \mu$, irregularly arranged.

On posts in an open field near Aibonito, Fink 1874.

4. *Phaeographina nitidescens* n. sp.

Thallus thin and smooth, lustrous greenish gray to light olivaceous; apothecia short and narrow, $0.5\text{--}2.5 \times 0.15\text{--}0.25$ mm., immersed and seen with difficulty, scattered or rarely clustered, straight to curved, very rarely branched, the disk closed and indicated by a line or finally and narrowly open and concave, the exciple rudimentary or absent, the apothecial structures covered by the thallus; hypothecium and hymenium hyaline; paraphyses hyaline, distinct, and unbranched; asci broadly clavate, the wall moderately thickened in the apical region; spores 1, hyaline to brown, oblong to oblong-elliptic, muriform, 27–39-septate transversely and 5–9-septate longitudinally, $70\text{--}110 \times 20\text{--}35 \mu$.

On bark in wooded areas of El Yunque at 2200 ft., Fink 724.

5. *Phaeographina scalpturata distorta* n. subsp.

Apothecia short, becoming variously distorted, the thalloid exciple becoming strongly developed and showing an irregularly incurved margin, partly or wholly covering the disk; spores 1 or 2, brown, oblong-elliptic, muriform, 18–59-septate transversely and 9–17-septate longitudinally, $60\text{--}200 \times 15\text{--}50 \mu$.

On bark in woods near Aibonito, Fink 1808 and 1900 (type).

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THE PERFECT STAGE OF HENDERSONIA MALI¹

L. R. HESLER

A few years ago apple twigs bearing the fungus *Hendersonia Mali* Thümen were collected at Hemlock Lake, New York. Accompanying this conidial form were perithecia, asci and ascospores characteristic of the genus *Pleospora*. When cultures of ascospores were made the resulting growth yielded *Hendersonia* conidia which agreed morphologically with those noted on the apple twigs. Further study of the ascomycete has proved that the fungus is a new species.

Perithecia were removed to a sterile drop of water in a sterile petri dish. Further procedure ensued along one of two general lines: (1) by means of a capillary pipette (as previously described, Hesler 1913: 291-292) a single ascospore was removed either (a) to a drop of sterile water in another sterile petri dish into which warm potato agar was then poured, or (b) to a hard potato agar plate prepared in advance; (2) warm potato agar was poured into a dish in which ascospores had been placed. When the dish and contents were cooled single ascospores were marked for further study.

Under conditions described above ascospores germinated within a few (8-12) hours, and pycnidia bearing pycnospores were matured within six days. A number of sowings were made to learn the genetic connection, if any, between the ascomycete and *Hendersonia Mali* Thüm.

After concluding that such connection did exist, apple twigs on young trees in the field were inoculated on different occasions in the months of June and July (1915). In each case no evidence of pathogenic action could be detected. The fungus apparently died and the incisions (prepared to serve as infection-courts) healed. Scott and Quaintance (1907) call attention to the

¹ The writer is indebted to Dr. H. M. Fitzpatrick, Cornell University for counsel in this investigation.

prominence of *Hendersonia* among several fungi associated with apple leaf spots, but they are not clear as to its parasitism. Scott and Rorer (1908) inoculated apple leaves with *Hendersonia* conidia but negative results were obtained. They concluded that the organism was probably saprophytic. Lewis (1912) isolated *Coryneum foliicolum* Fuckel from apple leaves in Maine. He made inoculations on leaves finding that the fungus grew and fruited on dead areas of leaf tissue but formed no new lesions. The possibility that this fungus might be confused with *Hendersonia* has been pointed out by Hall (1915).

It appears that, according to the cases noted above, *Hendersonia Mali* Thüm. is saprophytic on apple leaves and twigs. The common occurrence of the fungus on apple, however, occasions some interest. Further study may reveal a pathological angle not now evident.

Host indices available do not list a species of *Pleospora* on apple. After preliminary study of Saccardo's descriptions all forms were eliminated from consideration except *Pleospora aculeorum* Berl. On examination of Berlese's Monografia (1888) an additional species, *Pleospora Principis* Passer., appeared related to the fungus on apple. Attempts to locate in the United States exsiccata of these and other species of *Pleospora* suspected of being closely related to the apple fungus were unsuccessful. On request, Professor O. Mattirola, Torino, Italy, sent from Passerini's collection a fragment of *Phoenix dactylifera* bearing perithecia of *Pleospora Principis* Passer. He sent also a specimen labelled *Pleospora aculeorum* Berl. but the perithecia bore no asci nor ascospores. After making a study of the material sent by Mattirola, it is evident that the fungus on apple is different from *Pleospora Principis* Passer. From the figures and descriptions of Berlese it appears that the apple fungus is also distinct from *Pleospora aculeorum* Berl. Therefore the apple fungus is a new species and is herewith described as follows:

***Pleospora Mali* n. sp.**

Perithecia scattered, small, $144 \times 178 \mu$ (horizontal by vertical), range $121-170 \times 154-195 \mu$, black, covered, without a subiculum, ostiolum broadly conical; asci clavate or cylindrical-clavate, rounded at upper end, rather short stalked, $16.7 \times 98.4 \mu$,

range $16-18 \times 93-110 \mu$; ascospores irregularly or obliquely uniseriate at the base and upper end, sometimes biseriate between, $9 \times 19 \mu$, range $8-10 \times 15.8-22.3 \mu$, constricted at the middle, rounded on both sides, mostly obtusely-conical tip, few with rounded tip, gelatinous sheath not evident, mostly 5-7-septate, primary transverse septa thicker than others, the two to four or more middle cells once, rarely twice, longitudinally divided, yellowish at first, becoming brown at maturity; paraphyses slender, longer than the asci.

Habitat: In bark of dead apple twigs, Hemlock Lake, N. Y.

According to Berlese's *Monografia* (1888) the genus *Pleospora*, which was established in 1857 by Rabenhorst, is divided into groups on a basis of number of transverse septations in the ascospores. The fungus on apple falls into Berlese's group D—species with spores transversely 6-7-septate, one to three cells longitudinally divided, spores pleosporaceous, $20-35 \mu$, perithecia membranaceous.

The ascospores of the apple fungus are described above as transversely 5-7-septate. Approximately 4 per cent are 4-septate, 46 per cent 5-septate, 37 per cent 6-septate, 13 per cent 7-septate. The majority of the spores, it is seen, are five- and six-septate, although seven-septate spores are in sufficient numbers to attract attention. Very often the three or four middle septa are noticeably of greater thickness than those at the ends of the spore. In some cases the transverse end septa are indistinct. Occasionally a transverse septum extends but half-way across the spore, joining with the longitudinal wall of that cell. Longitudinal septa passing through all cells are uncommon, although the three or four middle cells are frequently so divided. Occasionally a cell shows two longitudinal septa. The end cells are sometimes longitudinally divided. Occasionally in the end cell a longitudinal and an obliquely transverse septum join in a Y-shaped fashion.

The younger ascospores are yellowish. At maturity they are brown. The heavy primary, middle septa intensify the color effect of the whole spore.

Another character of the ascospores is the relative size of the upper and lower portions as they lie in the ascus. Most of the spores are broader in their upper portions than they are in their

lower. Not infrequently there is a distinct bulge about midway between the constriction and the upper end. Usually the upper portion has also a slightly greater longitudinal dimension than the lower.

The asci are typically 8-spored. One ascus was found with but seven spores, another with six. Almost invariably the basal spore occurs alone, lying lengthwise or obliquely. The other spores are arranged biserially, or uniserially, or in a manner combining these two types of arrangements. A complete biserial arrangement of ascospores in the ascus was not observed.

The perithecia of *Pleospora Mali* are scattered and relatively few in number on the material collected. Since only one collection has been made by the writer it is probable that the perithecial stage of *Hendersonia Mali* Thüm. is rare. Reports of its occurrence elsewhere are lacking. It is recalled, in this connection, that in the northern latitudes the perithecial form of *Sphaeropsis malorum* Berk. (*Physalospora Cydoniae* Arnaud) does not develop abundantly (Hesler, 1916). On the other hand it is frequently found in the South. Whether *Pleospora Mali* is likewise more common in southern states is not known; casual search made thus far, however, indicates that it is rare.

From the beginning it has been evident that *Pleospora Mali* is closely related to *Pleospora aculeorum* Berlese and *Pleospora Principis* Passer. Whether or not the apple fungus was the same as one of these two latter species was the question to be determined. From an examination of Berlese's Icones (1895), his Monografia (1888), Saccardo's descriptions in Sylloge (1891), and specimens of *Pleospora Principis* Passerini, sent by Professor O. Mattirola, it is certain that there are important differences sufficient to distinguish all three forms.

While admittedly there is a resemblance of *Pleospora Mali* to *Pleospora Principis* through size and color of perithecia, absence of a subiculum, septation and color of spores, there are noticeable dissimilarities in size and shape of the asci and ascospores. The asci of *Pleospora Principis* are broader and more bag-like than those of *Pleospora Mali*. The ascospores are rounded and subattenuated in *Pleospora Principis* while in *Pleospora Mali* few have rounded ends; most of the spores possess obtusely-

conical tips. The spores are larger in *Principis* than in *Mali*; about $5\ \mu$ to $6\ \mu$ longer and slightly broader. Paraphyses are not mentioned, nor figured, in Berlese's works (1888; 1895). In material of *Pl. Principis* from Italy examined by the writer there was clearly no indication of paraphyses. Probably a new species in this group of fungi should not be recognized on the basis of this character alone. Little is known of the constancy of this character; paraphyses are not always distinct in a species in which these structures certainly occur. The morphology of the asci and ascospores however clearly separates *Pleospora Mali* from *Pleospora Principis* Passer.

Pleospora Mali is more nearly like *Pleospora aculeorum* than *P. Principis*. This resemblance is found in the character of the asci, ascospores and paraphyses. The form of the asci is similar and the size and septation of the ascospores are approximately the same in *aculeorum* and *Mali*. Striking differences, on the other hand, lie in the morphology of the perithecia, and in certain characters of the ascospores. The perithecia of *P. Mali* are noticeably smaller ($50\text{--}75\ \mu$) than those of *P. aculeorum*. The latter fungus has a subiculum which is distinctly absent in *P. Mali*. Probably this character alone under certain conditions is sufficient to justify separation of the two species. There are, however, important differences which clearly separate the two forms. The ascospores of *P. Mali* are more consistently constricted at the middle than those of *P. aculeorum* Berlese. The ends of the ascospores are obtusely conical in *Mali* and rounded in *aculeorum*. A striking difference between the two species is found also in the color of the ascospores; the spores of both forms are yellowish when young, but at maturity those of *P. Mali* are brown while those of *P. aculeorum* Berl. are olivaceous, or yellow-olivaceous.

In spite of the fact that *Pleospora Mali* is saprophytic, its occurrence on a substratum which is very different from that of *P. aculeorum* (on rose) and *P. Principis* (on date) should also have some weight. In the absence of nutritional studies, the separation of these forms must rest on a basis of their morphology.

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NOTES AND BRIEF ARTICLES

Dr. James R. Weir, pathologist in charge of the office of Mycological Collections, Bureau of Plant Industry of Washington, and who was for several years consulting pathologist for the Bureau with the U. S. Forest Service in the Northwest, has been appointed pathologist for "The Rubber Research Institute of Malaya" at Kuala Lumpur, Federated Malay States. Dr. Weir sailed for the Orient sometime in April.

FLESHY FUNGI

The cool moist season of 1926 in southern Ontario accompanied if it did not cause unusual conditions of the fleshy fungi crop. Veteran mycophagists are asking one another: Do you ever remember a year before this one when you could not find a single meadow-mushroom? The smooth lepiote, *Lepiota naucina*, usually locally abundant in September, was equally well hidden.

On the other hand certain Amanitae, Hygrophori, Cortinari, Tricholomata and Boleti were unusually large and abundant. Large Psalliotae—*subrufescens*, *abruptibulba*, *arvensis*, etc.—made up for the scarcity of *campestris*. Parasol mushrooms over a foot high—one dried example is now 34 cm.—growing in a shady grove the last week of September reminded me of the illustrations of imagined scenes in John Uri Lloyd's Etidorhpa. I have to go back in my notes thirty years to find a record of *Amanita muscaria* approaching in size and brilliance of color several that I saw this year. Some American writers question that we have the brilliant scarlet forms of that plant which European artists find and love to paint, but some of these fly agarics were as brilliant in color as any plate of them that I have seen. The largest one of two or three dozen that I observed on Oct. 4th, on less than an acre of mixed woodland, was 23 cm. tall and measured 18 cm. over the pileus which was 6 cm. across the strong blood-red center, lightening out by indefinite zones to the rich orange margin. The gills were pure white; the under

side of the ample annulus and the stem below it were yellow. I think it was the most attractive agaric that I ever saw.

In Essex Co., *Lepiota Morgani* had to its account at least one poisoning serious enough or frightening enough to involve a physician's services. Professor G. R. Bisby informs me that he has a photograph of a 1926 specimen of *Agaricus arvensis* that measured 13 inches across the cap and weighed 4 lbs. 5 oz. It was, however, found in Alberta.

JOHN DEARNESS

THE YELLOW-GILLED RUSSULA

During the summer, when most species of *Russula* are fruiting, insects are so abundant and the plants so scattered that the mycophagist cannot depend very much upon them for his table. But I have found the yellow-gilled species very satisfactory, both in Virginia and northern Florida, for several reasons. It appears in the fall when the cool weather keeps the insects in check; it grows gregariously and appears abundantly in the open pine woods, coming up under the masses of needles, sometimes half a dozen or more together; and all parts of the hymenophore, including the tender, fleshy stem, are edible.

During the latter part of October, it was abundant about Lynchburg, Virginia, while at Gainesville, Florida, I collected it frequently toward the end of November and later for my table. The species is a pretty one and readily recognized among the red species of the genus by its distinctly yellow gills. When very young they are white like those of *R. emetica*, but they very soon become yellow and there is no reason to confuse the two species.

In cooking the yellow-gilled *Russula*, I simply cut off the base of the stem; wash off adhering bits of dirt and trash; cut into halves or quarters according to size; and boil in a little water with salt for five or ten minutes until thoroughly soft. Evaporated milk and a dash of black pepper make excellent seasoning. Serve on buttered toast.

The autumn in Florida was quite dry and few fleshy fungi were found in November. On November 27, however, I collected enough for a mess by mixing *Pluteus cervinus*, *Lactaria Indigo*,

Lactaria laccata, *Hygrophorus miniatus*, a species of *Helvella*, and the yellow-gilled *Russula*. On the following day, I found a quantity of the last species in a little pine grove and used it alone. The squirrels here are very fond of this species.

W. A. MURRILL

GAINESVILLE, FLORIDA,
November 29, 1926

